AVIATION
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America's Aeronautical Industry

A Record of Labors Engaged In and Victories Won

THE pages of AVIATION are normally devoted to reporting particular events, policies, and methods, and to describing particular pieces of equipment. That is our principal business. Once in a while, however, it seems a good idea to make a survey of the American industry and its products as a whole, and to see just where we are going in comparison with the rest of the world.

It is a little odd that there should be any possibility of speaking of the American, or the British, or the German, or the Italian industry as a whole. The law of gravity is the same in all countries. Chrome-molybdenum steel and duralumin have the same properties everywhere, and a controllable-pitch propeller is just as much of a help in getting off from a small field in Persia as it is in getting off from a small field in New Mexico. It is a curious fact, however, that there are strong national tendencies in airplane design. In many countries there has been a disposition to settle down and work along certain lines which have proved fairly satisfactory, and not to worry particularly about what is being done abroad. There are more characteristic differences between a British and a German airplane, for example, than between a British and a German ocean liner, or between British and German machine tools. Some countries have been faithful to biplanes, others to monoplanes. Some have been quick to accept aluminum alloy construction, others have preferred welded steel, still others adhere to a special faith in steel strips assembled by riveting. Wood-covered wings are gospel in one country, metal-covered wings in another, while a third will have nothing to do with any covering except fabric. National projudice and force of national habit seem to rise superior to natural law as determined in the laboratory or by cold-blooded comparative tests in the field.

Of course these national differences are by no means due simply to prejudice or to habit on the part of aircraft and engine constructors. In some cases they come directly from military headquarters, or from that particular department of the government that is charged with determining airworthiness and issuing licenses. If the high command of an air force has made up its mind that only biplanes can be fit military craft, it is a pretty safe guess that the manufacturers that are trying to sell to that particular air force will devote all their attention to designing the best biplanes possible and will waste no time in trying to thrust monoplanes down the reluctant throat of their military market. By the same token, if the chief of the airworthiness department of a government gets it into his head that some particular type of construction is unsafe most of the manufacturers that have to get their designs approved by his department will find it easier to accept his views than to start a fight in which their opponent will be the referee and the timekeeper as well—judge, jury, and executioner all rolled into one. However sure a manufacturer may be that his particular government airworthiness department doesn't know what it is talking about, it is only very rarely that he is either brave or stubborn enough to refrain from going along with its prejudices with a shrug of his shoulders.

If there is a single respect in which the American aircraft industry has had

extraordinarily good luck in the past decade, it has been in the comparatively infrequent appearance of prejudice of this sort on the part of the military authorities (or, what is almost equally good, their disposition to shift about from favoring one form of construction to favoring another, so that all get a trial in due course) and its virtual nonexistence in the airworthiness section of the aeronautics branch of the Department of Commerce. That has been very good fortune for the industry, and the industry has been able to take the fullest advantage of its good fortune because many of its leaders have themselves been free from design prejudices (while among the others there has been a very wide variety of prejudices that has led them collectively to try everything, and to make a doggedly persistent exploration of almost every possible theory or notion) and because they have had, too, the humility to regard with a respectful eye any innovation that has come from abroad and to seek in each case to discover the merits of the imported or visiting products in the hope that they may be adopted and improved upon. The eagerness with which the first Junkers, the first Fokker, the first Breguet, the first DeHavilland Moth, and the first Savoia Marchetti flying boats to reach these shores were visited and examined by leaders of the American industry are the best possible evidences, not of weakness in American design but of strength. When a man begins to think that he has nothing more to learn and no competition to fear and that he can be contemptuous of the rest of the world he is just about to be the principal actor in a dismal débâcle, and what is true of the individual is true of the nation. When the American industry, or the industry of any other country, falls into the way of thinking that its products, be they aircraft or millinery or golf clubs, are superior to those of all the rest of the world by natural law or divine right or by simple confident assumption, and that it always will be so and that the industry concerned has nothing more to learn, there is sure to be plenty of thick weather ahead. That happens occasionally. It has happened in various countries, in aviation and in plenty of other industries. It would be discourteous and invidious to mention particular cases, but almost everyone can recall instances of national over-confidence for himself and can see the trouble to which it has led. That particular sin is one from which the American aeronautical industries have been, it seems to us, comparatively immune.

Why buy American?

The people that build airplanes and engines and accessories in America believe that they have good products. Generally speaking, they believe that their products are at least as good as any others in the world, and in many cases perhaps a little better, but as a whole they fortunately avoid the mistake of supposing that they have attained perfection or of being unduly satisfied with themselves or their work. If any particular American product is better than its foreign rivals, and therefore deserving of particular favor in world markets, it isn't because Americans are any cleverer than other people nor because of any peculiar quality in the American climate but rather because of certain advantages that come from our general industrial organization, because of the liberality with which research work (particularly that sponsored by the government) has been carried on and the sensible and practical direction that most of it has taken, and because the good fortune already alluded to has given us an open-minded governmental supervision and an open-minded industry ready to give all manner of schemes and all sorts of designs and all sorts of materials a fair trial. Those are the major reasons that underlie what special merits we may claim our present-day products to possess. There has been a deal of ingenious design and invention in those products, but no nation has any monopoly on ingenuity. Minor factors in our favor, helping our industry to turn out a product particularly suitable for wide distribution, are the geographical extent of the United States and the immense variation of climate, altitude, terrain, and degree of industrial development within American boundaries. The airplane (or for that matter the automobile) that is built for sale all over the United States has to be built to withstand such extremes of heat and cold, such high altitudes, such storms of dust and storms of rain and sleet, and at times such primitive conditions of servicing and repair facilities that when it has been adapted to meet all those extremes it is ready to go anywhere else in the world and make a reputation for itself.

Aircraft to fit alien terrain

One constantly encounters surprising examples of the extent to which little variations between the operating conditions for which a piece of machinery was designed and those to which it is actually subjected may make all the difference between success and failure. There was a good illustration a few years ago, when a number of small airplanes of a certain European type which had a magnificent record at home were brought to the United States, and promptly began to give a great amount of trouble with failures of landing gear fittings. The discrepancy between the performance at home and performance abroad seemed almost too great to believe until inquiry developed that a few machines of the same type that had gone to northern Africa and to some of the drier parts of Asia had given exactly the same trouble as in the United States. Knowing that, it was easy to deduce the reason. On the springy, sodded, rain-softened fields at home the landing gears stood up beautifully. On the bare and sun-baked surfaces of the tropics, or on the hard-surfaced runways of the United States, the impacts of landing were sharpened just enough to produce quick fatigue failures. The American manufacturer is quite as likely to make a mistake in proportioning a structure as is any other manufacturer, but he is much less likely to remain in ignorance of his own mistake, for the area of the Continental United States includes at least fair approximation to all of the worst conditions in the world. A product that is going to give any serious trouble in the export field, or prove seriously unsuited for service anywhere in the world, will be quite sure to show signs of the trouble or the unsuitability while it is undergoing its trials at home.

Do we know our own industry?

Though we are writing a few pages of general review with our foreign friends principally in mind, we suspect that most Americans will find them worth more than a casual glance. So much has happened in the last four or five years that no one could keep track of it all. It was with some little astonishment that the editors of AVIATION discovered, when we began to collect material for the purposes of this article, how very much of it there was to collect. We imagine that most of our readers, however varied their own experience may have been, will find as we did that they still have something to learn from a survey of the particularly striking accomplishments of their industry.

There is one thing, however, that no American interested in aviation will need to learn at this time by reading a magazine. No American will find it necessary that any evidence be supplied to prove that the representative products of the American aeronautical industries are sturdy, and reliable, and honestly built, and well finished. If we go abroad, however, we will still encounter here and there the absurd belief (its absurdity quite easy to demonstrate from innumerable examples) that America and America alone is the home of "mass production," and that "mass production" means that American goods must be rough and crude. The answer to that remarkable theory is furnished by any number of competitive tests, or by actual comparative examination of the quality and uniformity of the material, workmanship, and finish in American aeronautical products and those of non-American origin. We have the greatest respect for the industries of the other great aeronautical powers, and we certainly claim no monopoly of virtues for the American product, but we do claim that it in its turn deserves full respect and that it has certain peculiar advantages which have particularly fitted it

for general sale in foreign markets. That the merits of American aeronautical material are making themselves felt, in spite of currency irregularities, tariffs, and all kinds of economic difficulties, is evidenced by the export trade figures, which show shipments to foreign customers in 1932 far exceeding those of the previous year and coming within 15 per cent of the record of 1929, while at the present rate the 1933 shipments seem likely to eclipse even the 1929 statistics.

It may possibly seem that in our review of the particular claims to eminence of the American industry and of the reception that its products have had in foreign fields we are giving too much space to history. It may seem that it matters very little who first did a thing three or four years ago, if everyone else subsequently picked up the idea and if everyone is doing it now. The imitator can easily improve on the originator in detail of execution.

Nevertheless the record of pioneering contribution is important, for it is usually safe to guess that the pioneer who has already made important new contributions is likely to keep on making them. Between the man or the industry that originates and the one that follows on and tries to improve in detail there will always be a certain gap, and to get the earliest possible benefit of innovations it will always be necessary to go directly to the innovator. For poetic support we turn to the unofficial poet laureate of the British Empire, and we leave it to him to lay down a general principle that any well-mannered industry of any nationality would be too modest to lay down in the form of a claim for itself.

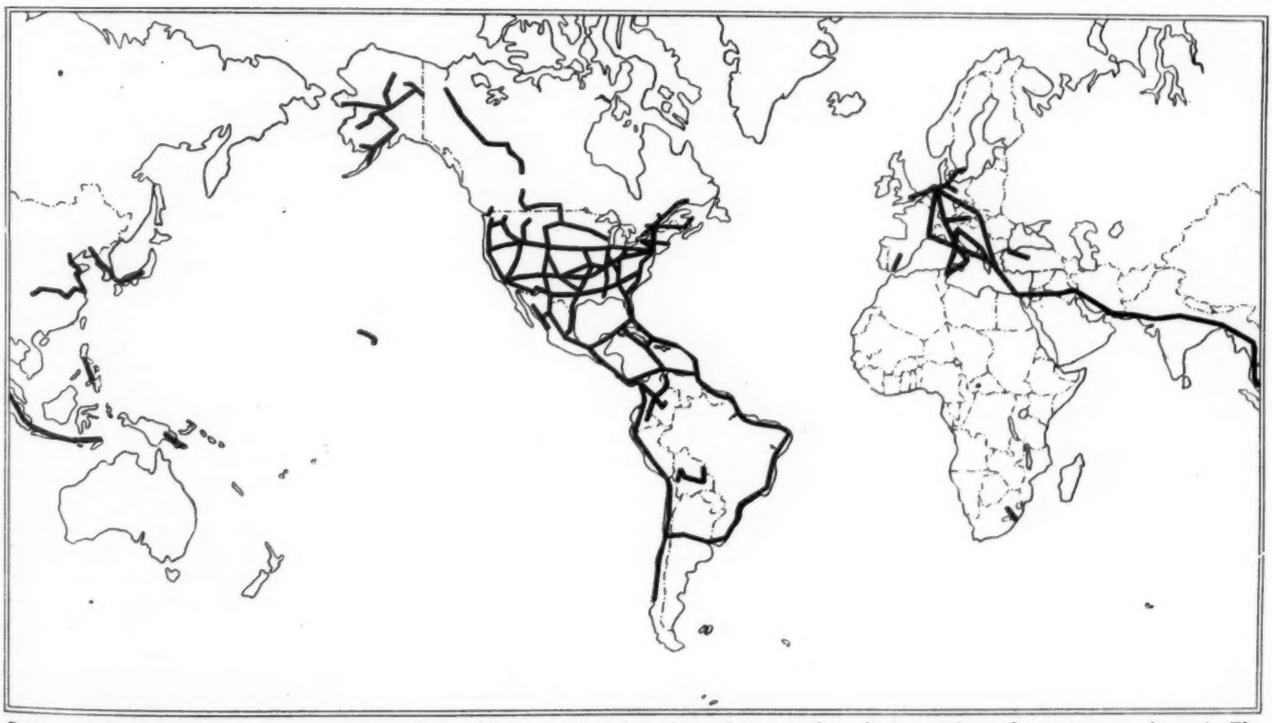
"And they asked me how I did it,
And I gave 'em the Scripture text
You keep your light so shining
Just a little in front of the next;
They copied all they could follow,
But they couldn't copy my mind,
So I left 'em sweating and stealing
A year and a half behind."

The company, or the industry, that has been a year and a half ahead on at least its fair share of occasions in the past is likely to be quite worth watching in the future.

Civil Airplanes

TO START with what is commonly known as an Irish bull, the most striking feature that American civil aircraft possess in common is their diversity. While the designers of other nations were settling down in most cases to a comparatively small number of standard types, American engineers set out with the laudable aim of trying everything. As a result, our industry has long offered upon the world market airplanes of almost every possible size, with all sorts of engine powers and consequently all sorts of performance and at all sorts of prices, biplanes and monoplanes, open and closed. Some of the types have essentially paralleled what has been done elsewhere, but others have been characteristically American. Almost purely American for many years, for example, and preeminently American even yet, is the cabin plane with accommodations for from four to six passengers and with the controls inside the cabin so that the owner of a plane can fly it himself without being isolated from his guests. Still smaller cabin types, for two or three persons, also made their first appearance in America and made their reputations here.

These moderate-powered cabin planes, of the category of the Bellanca, Stinson, or Waco, seem peculiarly suitable for a great part of the service that airplanes are called on to perform in many parts of the world, particularly over great areas of South America, northern Europe, Japan, South Africa and Canada. That their virtues do not go unappreciated is evidenced by the number of foreign sales that have already been made, and made without any "high pressure" sales effort. In Canada, where the products of American shops are almost as familiar as in the United States, about 20 per cent of all the planes appearing in the last issue of the general register, and some 40 per cent of those commercially operated are American-built cabin ships of this four-to-six-passenger type. It is particularly suitable for service wherever surface transport is such that the airplane must be frequently used for business purposes, or where the climate makes flying in an open plane unpleasant. It is most astonishing, yet it is a fact, that the type has been almost ignored by builders outside of the United States. A typical observation from a European



Commercial transport lines in all quarters of the globe are using American planes, engines, instruments, and accessory equipment. The lines on the map indicate the routes on which American planes or engines are now in use. [This map, like the one on page 261, has been prepared with all possible care from the best sources available. In spite of everything, errors may still exist. If so, we hope our readers will call our attention to them.]

purchaser driven to the United States by a process of elimination was that of Lady Grace Hay-Drummond-Hay, just after buying a four-place cabin biplane in the United States: "I don't feel that I am unpatriotic in buying a foreign aircraft, because I require a machine that has not been developed in England. . . . The construction and finish leave nothing to be desired."

Extraordinarily high praise from several owners who have had experience with American airplanes under European conditions has been forwarded to us by an English correspondent, who himself says: "So far as the operators are concerned, American types seem to fulfill their needs more closely than any other types. They are always demanding higher speeds, and they often point to American machines as being suited to work in Europe. Experience of private owners of American aircraft in England confirms the views of the operators of public airlines."

Mr. Owen Cathcart-Jones, who has had experience in England with two American cabin planes, says of the four-passenger cabin monoplane which he had flown for 300 hours in England and on the continent of Europe: "It was a genuine four seater, extremely comfortable, had a remarkable take off and slow landing speed, was fitted with all modern refinements in the way of electric starter and wing landing lamps, and when in the air practically flew itself. . . . The only replacement during 300 hours was one rocker arm to the motor. The lay-out of the cabin in this aeroplane made it not only a pleasure to fly, but enabled all the occupants to converse in ordinary tones without using a megaphone. Of a high speed cantilever monoplane of American manufacture, Mr. Cathcart-Jones further says: "I can only say that the all round performance of this aeroplane was so far ahead of anything yet produced in this country that comparison is impossible. At the date of first entry into this country it was faster at sea level than any of the single seater fighters produced in this country, and at the same time accommodated seven people in absolute comfort. After making record flights to Cape Town, and a record flight of London to Paris in 72 minutes (at little over normal cruising revs.) I operated this particular aeroplane privately for over one year and the maintenance on the motor cost under five pounds ($20) for the year. . . . Prior to its introduction into Great Britain, it had been the opinion of the majority of air pilots and aviation authorities in this country that the ship could only be operated from large flying fields with concrete runways; and it was rather a shock when it was demonstrated that not only could it be operated from every aerodrome in Great Britain, but that the undercarriage was of such exceptional construction that it withstood the rather uneven surface of some second grade flying fields of small dimensions, when being taken off and landed under full load conditions."

Mr. F. W. Bourne, who has for some time been piloting the four-passenger American monoplane owned by Col. E. P. Johnston, says among other things: "I have flown for some 250 hours in England, France, Italy and Germany and have never once had any form of trouble with the machine or engine, neither of which has needed any repairs. The cabin provides really comfortable seating for the pilot and passengers. The heating and cooling arrangement is excellent and there is very little noise to worry the occupants. The landing brakes are first class and the pilot can put the machine down safely in a very short space if necessary while the undercarriage being very strong and wide will withstand heavy landings and rough ground. In the air the airplane is very easy to handle and not at all tiring to the pilot. Also it is very safe near the ground with wonderful lateral control at slow speed. It is extremely maneuverable on the aerodrome." Mr. Bourne offsets his high praise with a few criticisms, such as a suggestion of larger tank capacity, all of them to be easily met by minor modifications to fit special conditions.

High speed for private owners

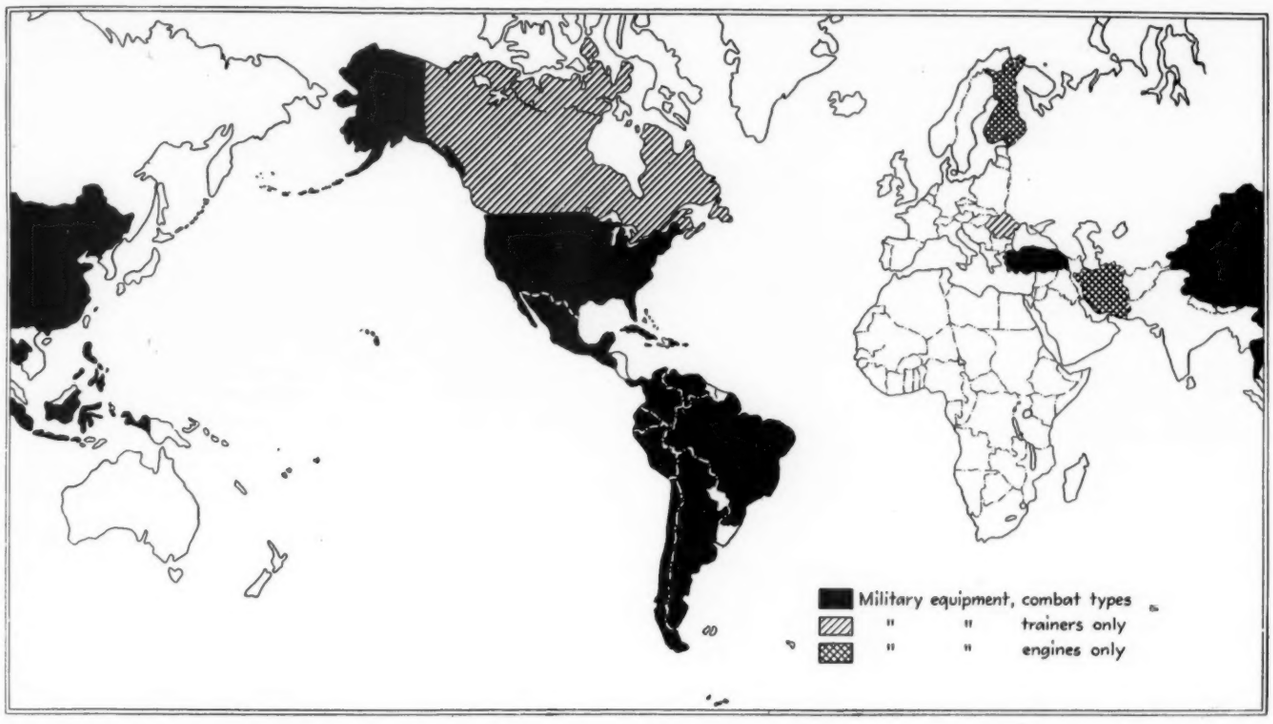
Almost purely American, also, is the "executive" type of plane, for those who want a moderate-size machine that will give them the last word in performance and luxury and are willing to pay a good price for it. Nowhere except in America, we believe, has it been possible during the past few years to get a cabin ship with comfortable accommodations for from four to six people and with a cruising speed of 150 m.p.h. or better. The great distances that have to be flown in America and the frequency with which a business engagement may require travel of 1,000 miles or more have created a demand for performance not paralleled in any other large aircraft manufacturing country.

By building these cabin planes the American industry has virtually created the industrial use of the airplane. The business man on a business errand generally won't have anything to do with an open machine, especially in a very cold country or a very rainy one, or he generally needs space in the cabin for at least four persons. On the other hand, the user doesn't want anything as big as a transport and he insists on a reasonable price. His specifications lead him straight back to the type of plane that has been a specialty of a number of American manufacturers.

At the same time that the American industry has been creating industrial flying it has made the lot of the aerial tourist easier by developing a type of open-cockpit plane that is roomy enough to handle two passengers and still leave plenty of room for luggage or to take three passengers with less baggage and miscellaneous loads. The exceedingly attractive two-seater sport planes that a number of European manufacturers build are sometimes a little narrow for a heavy pilot, particularly for a heavy pilot in a climate that requires him to wear a fleece-lined flying suit, and narrow fuselages also provide a somewhat limited luggage space as compared with what is possible in the 40-in. width of fuselage in the typical American three-seater. Of course the three-passenger plane is also ideally adopted for light commercial operations where the climate doesn't demand a closed cabin. It was originally developed in the United States principally for the "joy ride" or "hop" business, where the pilot was a professional and where passengers were likely to come in pairs and want to sit together. The operator who can handle them by pairs in a plane that costs no more to run than one that will take only a single paying passenger can count himself just that much to the good. Another species of aircraft for which America can claim most of the credit, and which the American market still offers in larger variety than any other, is the amphibian. Though there had been amphibians of sorts for many years, even before the war, the first models to come into any wide-spread use were the Loening and the Sikorsky. Now available in all sizes from two-seater up to 40, and with cruising speeds up to 140 m.p.h., American designs still hold the field, and there probably have been at least five times as many amphibians constructed in the United States for civil use as in all the rest of the world combined.

250-mile transport planes

A disposition towards high speeds has been even more conspicuous in American transport planes than in those intended for the private owner or industrial use. Roughly speaking, five years ago the typical transport cruising speed was about 90 m.p.h. on European airlines and about 100 m.p.h. in America. During the present summer it has reached a general level of about 110 m.p.h. in Europe, with occasional machines running as high as 130, and a common average of 150 m.p.h. in America with a number of services that go above 160 m.p.h. and some distinctly higher. Already we have on our transport market at least five types, two of them multi-engined, with cruising speeds well in excess of 160 m.p.h., and any transport operator who wants to set up and maintain a really sensational schedule will find American builders who are prepared to guarantee cruising speeds up to better than 180 m.p.h., with maximum speeds of well over 200. There are no transport planes as yet in actual service anywhere else in the



The rising tide of American built military equipment. The products of our manufacturing plants are used by air services the world over.

world which approach such figures, and we cannot discover that any machines with a cruising speed of 140 m.p.h. or better and offering comfortable accommodations for as many as eight passengers have ever been test-flown anywhere except in America. Already there is a tendency for lines that want to provide a high-speed passenger service to turn to the United States for equipment. A conspicuous example is the Swiss-Air operation between Zurich and Vienna, on which American planes and engines have been used for two years now, attracting great interest and some emulation by European constructors. Dr. E. Schatski, representative of Swiss-Air, remarks: "Through the big possibilities of manufacturing and its bigger market, the American aviation industry was able to make its products so reliable and at the same time cheap enough to find the interest of European producers. . . . Swiss-Air, which used to buy European machines in former times, was so impressed by the speed of the Lockheed Orion that they made their first experiments with American machines in their service. Swiss-Air used the plane on the airline between Zurich, Munich and Vienna and was able to reduce the scheduled time about 40 per cent. The Orion and the Cyclone engines proved their complete reliability, and no severe trouble was encountered. . . . The maintenance of the plane did not make difficulties, and the results were so satisfactory that Swiss-Air decided to buy another but a larger machine in America, the passenger capacity of the Orion not being big enough for the increased traffic. The contract was made with General Aviation for a Model GA Clark 43. This airplane is equipped with the Wright Cyclone F2, the controllable pitch propeller of Hamilton Standard, and with American instruments."

The development of engines of very high power and of the most compact dimensions has of course played a large part in the sensational improvement of performance that has marked the last few years and in keeping the performance of American commercial planes well ahead of practically all of their rivals from other parts of the world, but power increase has not been the only factor. The careful fairing of fuselages and the avoidance of the box-like forms that have marked many of the transport planes of European origin has been an important item, and so has the use of retractable landing gears. It is a remarkable fact that, although it is now thirteen years since the first retractable gear to be fitted on an American racing plane was shown in Europe, not even up to the present time has a single landplane with a retractable gear been put into any real production, anywhere in the world except in the United States. With a mass of evidence accumulated to show increases in maximum speed of from 10 to 20 m.p.h. by the use of the retractable gear, with net increase in weight of no more than 2 or 3 per cent of the gross weight of the airplane and with little or no increase in maintenance cost, it is truly extraordinary that the retractable gear is allowed to continue almost as an American monopoly. At first it was regarded with a great deal of skepticism by many American engineers, but experience has converted them, and now there is hardly an American manufacturer who hasn't put the retractable gear onto at least one model. Purchasers wanting the utmost in performance are likely to look to retractable-landing-gear headquarters to get it.

Fruits of research

They are likely to look, too, to the industry that has had the benefit of the full-scale test apparatus of the National Advisory Committee for Aeronautics and of its very careful and exhaustive research on engine location and engine cowling. Perhaps the largest single factor in the increase of speed and general improvement of performance of multi-engined airplanes in the last two years has been the general adoption of the engine locations recommended by the Advisory Committee.

All these general features of design that mark typical American planes are important, but perhaps it is foolish to enlarge upon them at too great a length in print, for they can be seen from the outside. Performance figures speak for themselves, and assembly drawings and photographs make the features and form that affect aerodynamic efficiency quite plain. We must not overlook now those structural details which general views of the airplane fail to reveal, but which are quite as important as wing sections and engine cowling in determining whether or not the plane is going to be satisfactory to its owner.

Again there is plenty of diversity. All

manner of materials and all manner of types of fabrication have been tried, including some that had been entirely unknown elsewhere, such as the process of "shot-welding" stainless steel developed in America some three years ago and since licensed to several European companies wishing to use it in their own operations. Such variety is all to the good, for in selling to the world market varying conditions demand varying structures. Thus in some tropical countries where boring insects and fungous growths flourish the wooden structural parts of airplanes may almost disappear overnight, and duralumin or steel is definitely called for. In other areas, of more temperate climate and not yet in a very high state of industrial development, wooden structures are still far preferable to metal because of the ease with which repairs can be made by the available labor. In practically every part of the world except on a treeless desert or among absolute savages skilled woodworkers are to be found, but artisans in metal are not so easy to locate in (for example) the interior of Siberia—nor in a good many other places.

Built for harsh treatment

Whether in wood or in metal, the structures of representative American civil planes are tough. They have had to be. They have been designed for all sorts of operations under a great variety of conditions, and the designers have had to expect the worst. They have had to plan for rough handling in the field and for rough handling in the air, for the American pilot, whether civil or military, has been notorious for his unwillingness to "baby" an airplane. Hence the prevalence of somewhat higher load factors in America than are common elsewhere, though the difference in that respect is much more marked in military than in commercial specifications, and hence the extreme rarity of structural failures in American planes for several years past. In a certain part of the Eastern hemisphere in which bumps of terrific violence occur in mountain passes, and in which simple rough-air loads have in several cases occasioned structural collapses of well-known machines of European manufacture, the local agent for an American light commercial plane has made a practice to show his confidence in the ship that he handles by taking his demonstrator out and flying it repeatedly back and forth through the same passes under the worst conditions that he could discover.

Next to ruggedness of structure as a striking constructional feature is durability and beauty of finish. As it was in America that the first extensive use was made of pyroxylin finishes for automobiles, so it was here that highly polished lacquers for airplane fabrics first came into general use. It is still true, either because of the doping scheme used and the quality of the material or because of the amount of hand labor that is lavished on finishing, that American planes from first-class factories present a surface appearance that is hardly to be duplicated elsewhere. It has been the subject of the most favorable comment wherever American planes have been shown, even before the naturally critical eyes of European manufacturers and of representatives of the British and French aeronautical press.

A Russian transport airplane uses American engines connecting Berlin and Moscow

Cutting maintenance time

Insistence on ruggedness and easy maintenance in the field, a tradition inherited from the military service and strengthened by commercial experience, has led to the preparation of such elaborate maintenance schedules as those described in two articles by Ralph G. Lockwood in AVIATION in January and February, 1932. Nothing so detailed and specific has so far as we can discover ever been prepared elsewhere, and certainly nothing of the kind appears to have been published. The result has been an extraordinary improvement in the maintenance quality of American commercial airplanes from the 1929 crop to that of 1933.

The demand for easy maintenance and for a minimum of replacements in service has had its effect also in what may seem the most generous employment of certain mechanical refinements—as, for instance, ball bearings. In 2,000 hours of flying, the total relative movement of an elevator hinge would hardly exceed the amount of movement of a crankshaft of a high-speed automobile engine in its bearings in a single minute. Yet the use of self-lubricating ball-bearings on airplane controls has become common practice, and there have been even American designs in which they have been used in landing-gear struts.

Good maintenance quality, high performance, workmanlike construction, and fine appearance have all combined for a gradual expansion of the foreign market for the American commercial product. A gradually increasing number of planes have been sold abroad for private use, even during the depression and even in countries such as England that have highly developed and highly efficient aircraft industries of their own. On transport lines, quite aside from those under American financial control, American planes have been in use in territories as remote as Japan and Manchuria. The case of Canada is of course a very special one, for it is scarcely possible for an American to think of Canada as foreign territory, and yet it is flattering to our self-esteem to find that in June Canadian Airways, the great system of air-transport lines that runs from the Gulf of the St. Lawrence to the mouth of the MacKenzie River, was using 37 airplanes of American types as against fourteen of all other nationalities combined.

Military Airplanes

EUROPEAN airplane manufacturers have shown no such indifference to speed in military airplanes as has characterized their civil plane design. Especially since Great Britain and Italy began to take the Schneider Race seriously, the power output of engines has been increased and the lessons in aerodynamic refinement that have been learned on racers have been incorporated in fighting-planes so that the fighting-ship speeds have gone up in a steady and rapid progression. Sometimes one country has been ahead, sometimes another, but on the whole there has not been much to choose in speed among the leaders.

The special merit that can be claimed for American military planes of the smaller classes does not lie in any unique high-speed performance along the level, though they certainly have nothing to apologize for in that respect, but rather in the possession of a structure which makes it possible to throw the plane around the sky with a complete indifference to structural consequences that can hardly be equaled elsewhere. Without the power to stand violent maneuvering, speed is futile. It is unfortunately difficult to compare the airplane strength re-

quirements of various countries directly, for the methods of load factor calculation and the assumptions on load distribution differ too widely. For what it is worth, it may be recorded that the latest British specifications of which we have record require a maximum load factor at a high angle of attack of 8.5 for fighting-planes, while in America both the Army and Navy have for several years required a factor of 12. It may be recorded also that accelerometer tests for loads actually experienced in flight have repeatedly been carried up to load factors of 8 or more in American tests, both in trials of new aircraft and in the research work of the National Advisory Committee for Aeronautics. There is no published indication of any such terrific loads having been experienced in European trials. It was with an American fighting plane, it will be recalled, that the first outside loop in history was made.

Of much greater significance, however, is the known devotion of the American services to diving practice, both in fighting and in bombing, and their consequent firm insistence that all small combat machines, and certain types even of quite large size, shall be able to stand vertical dives to terminal velocity and sharp recoveries without permanent effect on the airplane. Though various European planes have been given terminal diving tests gentle recoveries appear to have been the regular rule, and nowhere else does diving seem to play so large a part either in the testing of new types or in the regular practical exercises of squadrons as in the United States. In particular, nowhere else has dive bombing with a machine capable of handling a heavy enough bomb to attack a lightly armored vessel, a fortification, or a masonry building been made a regular part of the exercises of an air force. The directing powers of air forces who plan to make extensive use of steep diving attacks, or of air forces whose pilots have a tendency toward heavy-handedness or an inclination towards violent acrobatics will find special occasion in the American military experience and equipment specifications to look carefully into the qualities of American military planes before deciding on their own purchases.

Aside from the exceptional sturdiness of structure of the American military planes, a quality that appears in all types, one must remark on the uniquely high performance of the ships of the heavier classes. It has long appeared a somewhat curious anomaly that whereas in the case of almost every other vehicle (and particularly of ships) the very highest speeds were likely to be associated with rather large size, in airplanes speed and size long appeared to be in direct opposition. There never was any reason for it. If anything a large machine should be cleaner and have a lower parasite resistance coefficient than a small one designed with equal care, since the cross-section of the fuselage can be smaller in proportion to the size of the wings. Yet for some reason it had never been done until a couple of years ago. All over the world, designers who were giving the most minute attention to fairing exposed parts and to improving the aerodynamic form of the fuselage in pursuit or sport planes seemed quite content to retain the good old chicken-coop type of structure on the heaviest ships and to allow the mileage of strut and wire to expand almost indefinitely. At the same time bombers and other heavy planes were expected to get along without supercharging or super-efficiency engines (those were reserved for the pampered fighting and racing types) and an arbitrary and an unreasonably low limit was often imposed on the power that could be used to carry a specified military load.

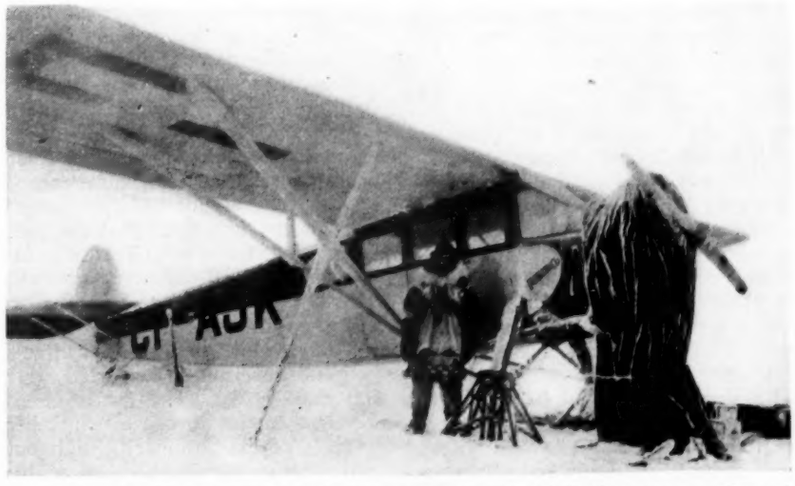
Bombers for speed

During the past three years certain American constructors have thrown those antiquated theories aside as nonsense. They have staked their confidence squarely on the logical possibility of getting the same performance out of a big plane as out of a small one and by using the best high-powered engines that were to be had and by making use of every available bit of aerodynamic knowledge, they have reached their goal. Even on a basis of equal power and equal wing area, the best of the American high-speed bombers actually shows an increase of from 70 to 90 per cent in aerodynamic efficiency over the best bombers previously existing, or a reduction in resistance at a given speed of almost a half. So it is that it has been possible to produce twin-engined bombing planes with a direct military load of well over a ton and with an honest top speed of 200 honest miles an hour.

The flexibility of the American industry's policies has already been emphasized, but it will stand repetition. The final outcome of much variety and experiment has been that the American industry is prepared to produce almost any kind of an airplane that may be asked for, and from almost any kind of material. It is even more true of military than of commercial planes that efficiency in the narrow sense is not the only thing to be sought in designing an airplane, and that service conditions may require the use of a structure that is a little heavier or a little less durable than some alternative type. Even though the general tendency has been away from wood and toward metal structure in the past few years, American manufacturers are by no means so firmly committed to metal that they cannot build all-wood or wood-and-steel tube airplanes, and there are a number of countries where air forces operate under conditions that made wood a very satisfactory material and perhaps the only satisfactory one. At the same time, of course, the physical equipment of American factories and the mental resources of design staffs are quite ready for all manner of work either in steel or in aluminum alloy.

Ease of mechanical care

Special attention to ease of maintenance has long characterized American military airplanes and indeed it was from the military models, their maintenance qualities developed under the spur of constant insistence by the Army Air Corps, that American commercial builders and operators drew the idea of definite man-hour specifications on maintenance jobs. Insistence on easy maintenance makes a good airplane, especially for military service in difficult country or in the hands of a mechanical personnel comparatively unskilled or seriously limited in numbers. Too much insistence, however, has dangers of its own It may, for instance, lead to a demand



In Canadian service, an American monoplane with ski landing gear equipment, engine starting hood, and other cold weather equipment.

that the whole airplane structure be simplified and kept to familiar form and that nothing new be incorporated. That pitfall has been avoided by the American military and naval services, and so by the industry that has designed and built to meet their requirements. American military airplanes have as a matter of fact been very quick to incorporate new accessories. They were the first to use wheel brakes as a regular practice. They were the first to use low-pressure tires as standard equipment. They were the first to popularize the tail wheel, and to eliminate the skid with its accompaniment of a neatly-ploughed furrow to mark every landing. From America came the first military planes with complete cockpit inclosure, offering the pilot greater comfort and better vision than can ever be obtained crouched down behind a windshield, and from America came the practical development and the demonstration of the retractable landing gear, which is still virtually unknown on military machines in other countries.

Demonstrations overseas

Naturally every country that has large industrial facilities prefers to build its own military airplanes, and not to be dependent on a foreign source of supply. The truly open market for the sale of military craft is thus much limited.

That American manufacturers have actually sold military planes in more than purely experimental quantities in fully two-thirds of the countries that can be considered as offering available markets is a better testimonial of the quality of their products than any amount of engineering discussion or written argument. Nothing quite takes the place of a demonstration, and where it has been possible to arrange for demonstrations as spectacular as those which Major Doolittle gave in South America some years ago and subsequently in Turkey and China and various other parts of the world orders have generally been quick to follow.

Still better testimony is furnished by actual operating experience after deliveries have been made. Military operations being what they are, it is often difficult to get full or reliable information on the performance of equipment and it is usually quite impossible to secure it for purposes of publication. A few scraps filter through, however. We know, for example, that the new training school of the Chinese national air forces is equipped with American training planes and that during their first year of service thirty of the ships were being flown a total of 1,000 hours a month on the average without having had a single mechanical failure in that time and with only two accidents, both due to pilot errors. The less rugged type previously used had been responsible for a number of landing crashes. A still better evidence of satisfactory performance of American military ships under overseas conditions is furnished by repeat orders, which have been frequent. They have, in fact, come from almost every one of the principal countries in South America. The responsible American industry has had a record clear of the unsavory practice of dumping abroad equipment that had proved unsatisfactory at home, and pleased customers, given good construction and up-to-date design, have come back for more.

Engines and Propellers

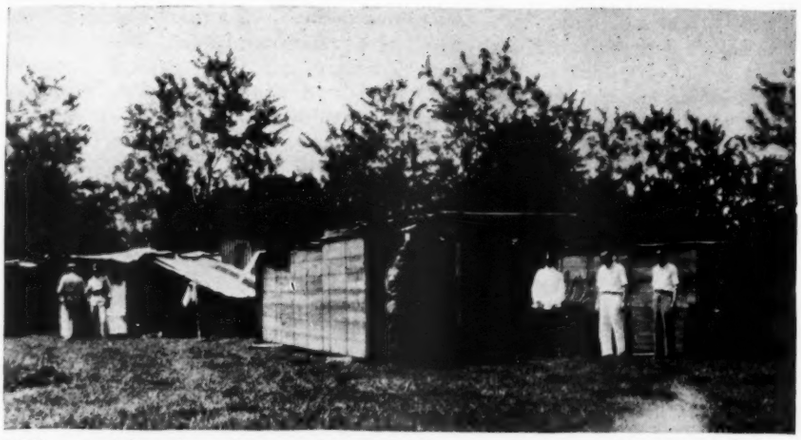
IT IS a somewhat unsatisfactory business to discuss the relative merits of various schools of engine design in terms of details of construction, or to attempt to analyze the reason why one engine is better than another. The engine designers themselves find such analyses not only interesting and profitable but necessary, but the airplane builders and operators who are in the market for power-plants are interested in only one thing, and that is over-all performance. They want, of course, performance in the broadest sense, including reliability and low maintenance cost and long life, but if those qualities are obtained they are not in the least interested in knowing how or why they were obtained, and they generally prefer to rely on dynamometer tests for power and on breakdown tests for reliability rather than upon any amount of inquiry into how the engine is built. Nevertheless there are some distinctive differences between American and European aircraft power-plant practice that are worth looking into.

The aircraft engine is a machine-shop product, and as might be expected it shows national tendencies in common with other machinery. The difference in conventional production methods between America and Europe is far less than is often supposed by people who have never studied American and European practices at first hand, but in a general way the American disposition is to try to design for a maximum use of automatic machinery and a minimum of hand fitting, while in Europe the lower rates of pay of highly-skilled labor provide no such incentive for the elimination of hand work. Another characteristic general difference between the engine-building arts in Europe and in America at the present time is that for several years the development of specialized engines for racing has played a large part in the industry's operations in England, in France, and in Italy, while in America there has been no government-supported air racing since 1926. There has resulted the development in Europe of a number of engines of extraordinarily high output under racing conditions but frankly designed to operate only for a very short time under those conditions and with the very best of care and a specially blended fuel. In America, on the other hand, all attention has been concentrated on building for regular commercial and military service, and there has been no interest in setting up power-output records with any engine that couldn't be expected to continue to carry its full load for at least 300 hours between overhauls. Of course many European power plants also have splendid records for service reliability, but there is often a wide gap between the maximum power under test or racing conditions and the power that the engine can be expected to deliver for a protracted period.

Close work in the foundry

American shop technique includes not only the development of as much automatic machinery as possible for machining operations, but also the elimination of machining operations wherever possible by forging or casting a part directly to the size required. Remarkable improvements in foundry practice have made it possible to cast aluminum-alloy air-cooled cylinder heads to their finished form, with finning completely surrounding all valve ports and rocker boxes and with an exceedingly close spacing of fins, a spacing in at least one case of only one-fifth of an inch. European practice, even where much more costly forged and machined heads are used, generally provides a substantially wider fin spacing.

Good design for cooling around valves, and the use of salt-cooled or sodium-cooled valves to conduct the heat from the valve heads to the stems and thence away through the finned guides, together with the fact that American radial engines developed gradually from small to large sizes and from moderate to high speeds and outputs over a number of years, have made it possible to adhere to a simple valve-gear with but two valves per cylinder. Multiple valves have been avoided in the interest of easier maintenance. Considerations of maintenance, too, have been largely responsible for the complete inclosure of valve gears (particularly important in desert countries) and a notable reduction in lubrication problems has resulted. High specific power output (some American radial engines are now in regular service at a rating of as much as 0.4 hp. per cubic inch of piston displacement, or 25 hp. per liter) has called for extraordinary attention to the cooling of all parts of the engine. Notable also is the improvement in the cooling of the rear of the cylinder barrels by the use of carefully-designed air deflectors placed between and behind the cylinders. Studies by the National Advisory Committee and by engine builders on the best locations for deflectors have made it possible to increase airplane performance substantially, since a better cowling can be used with a reduced flow of air through the engine



Military training planes to be used 8,500 ft. above sea level as received at Colombia, where they were set up.

without overheating when a proper system of baffles is employed.

Though rotary induction, or the use of a centrifugal blower in the rear section of the crankcase to distribute the mixture to the cylinders, was first proposed and first tried in Europe the most extensive applications as a regular piece of service equipment have been made in American engines. Instead of drawing upon rotary induction only when supercharging is desired, as in certain leading radials of foreign design, it is used in all cases and power can be stepped up and supercharging obtained by simply changing the gear ratio to the impeller. Power increases of more than 40 per cent have been secured in that way, of course in conjunction with the use of high-quality fuels. If the available fuel is not good enough to make it possible to run full throttle at sea-level, the gear ratio can still be modified and a throttle stop used so that sea-level detonation will be avoided and the full power output developed only at working altitudes.

Better fuels, bigger outputs

Wherever exceptionally high engine output is sought fuel is a problem, and American technology has made two particularly notable contributions to the fuel and lubricant arts. First, some fifteen years ago, came the emancipation of the aircraft engine from its dependence on castor oil for lubrication. Mineral oil is now so satisfactory and its use is so much a matter of course in American practice that the days when we were dependent on castor oil are classed as ancient history, but a much more recent development that is still very much in everyone's mind has been the introduction of tetra-ethyl-lead as a blending material to suppress knocking. It has sometimes been suggested by critics of American engine practice that American engines are bad for out-of-the-way parts of the world because of the impossibility of getting the high-grade fuels which they are alleged to demand. Quite aside from the fact that the general disposition in all countries is towards the use of higher quality fuels in order to get the utmost out of the engines and to cut their weight and resistance and that the distribution of high quality fuel is now virtually world-wide as a result, the fuel problem need occasion little worry in any event, for the occasional real emergency demands of exploratory flights or of air forces in out-of-the-way places can be met by securing a supply of ethyl fluid and blending it locally.

Chemical cooling

Though the liquid-cooled engine has had less public attention in the last two or three years than has fallen to the air-cooled radial, the single liquid-cooled type offered on the American market has remained well to the fore among service engines, excluding those designed simply for racing. The most brilliant American innovation in the field of liquid cooling has of course been the introduction of prestone or ethylene glycol as a cooling fluid, followed by the development of engines capable of using it without overheating and without developing leaks. Permitting a reduction of at least a half in the cooling surface of the radiator, Prestone has made it possible to step up the speeds of fighting planes with liquid-cooled engines by ten miles an hour or more, and it has made the wing radiator a possibility for regular military service.

Of course a great many structural details and new materials have played their part in improving engine performance and reducing engine weight over the past few years, and in general in producing the magnificently efficient and reliable power plant of today. The development of steel-backed bearings of lead-bronze alloy has been a major factor in increasing the time between overhauls and reducing the number of engine failures. There are plenty of other points that one might mention, but the best certificate of quality for an engine is found in the record of its service in the field. The best possible reason for foreign aircraft manufacturers and operators to buy American engines is found in the recorded opinions of those who have already tried the engines or those who have seen them on trial.

Outstanding among foreign commercial users of American power plants is the K.L.M. line from the Netherlands to the Dutch East Indies, a route that has been operated for considerably over a year with a consistency and efficiency to which tribute has already been paid in AVIATION (April, 1932). Over a total distance of 9,000 miles, American engines fly Dutch planes at the rate of one per week in each direction. Telling the story of the service and its technical problems to the Royal Aeronautical Society, A. Plesman, managing director of the company, recently said: "[the new machine] must also be equipped with the same Pratt & Whitney Wasp engines of 425 hp. with which the [previous type of plane] had attained such brilliant results." The same line is now working with Wright Cyclones and Hornets, as well as with the Wasp. On the service to the Indies the American engines are being relied upon to carry a landplane across 250 miles of open water, as good a test of reliability as one could desire. American engines have been used, too, in varying but in most cases substantial quantities, by the air lines of Switzerland, Sweden, Denmark, and Finland, as well as several countries in Asia and many in South America. Their performance was summarized by H. A. Seyffardt, conspicuous figure in Dutch aviation, when he said in a letter to AVIATION about a year ago: "The demand for greater efficiency and decreasing maintenance has opened the European market for American engines and accessories. The introduction of American air-cooled engines resulted immediately in an increase of 50-75 per cent of flying hours between overhauls due to greater reliability and better material compared to European types of engines. Moreover, the actual price per horsepower of the American engine is 25 to 40 per cent below the price of any motors of equivalent power manufactured on the European continent."

Propellers of metal

Propeller design has followed very much the same principles in all countries, but certain definite innovations stand to the credit of American design and in certain particulars the American industry appears for the moment to have a good lead over the rest of the world. It was here that metal propellers were first put into extended practical service, and they have now been in use for more than ten years in the solid-blade form and for half a dozen years in the adjustable-blade type, with such success that they have almost crowded wood out of the home market. Many metal propellers are now available in other countries—some of them built on license

from an American inventor, and some of them palpable imitations of the American adjustable-blade type—but the American propeller industry still represents the largest production and the longest and most varied experience. Long limited to forged duralumin blades, it now offers the opition of hollow steel.

Most varied and most extensive, too, whether or not it be longest, is the American experience with variable-pitch or controllable-pitch propellers. For almost twenty years the controllable-pitch propeller has been listed by every aeronautical engineer as one of those things that would exist in an engineering Utopia, but only within the past three or four years has a propeller been developed to the point where it is ready to go into general service in the hands of ordinary pilots and mechanics and on high-powered engines. Today America offers no less than four makes, operating with as many radically different mechanisms. All of them have been extensively tested, and two have been in wide use. They have reached the point of being installed on 60 transport airplanes in transcontinental service, they are being installed on practically all of the new high-speed transports now in development or on trial in America (as well as several of the new ships in Continental Europe), they are making rapid headway in the military service and they enabled Doolittle to make the world's speed record for landplanes and carried Wiley Post around the world. Such propellers become progressively more important as aerodynamic improvements make it possible to increase the speed range. American propellers with steel hubs and adjustable duralumin blades, like American engines, have been extensively used in military service and on airlines outside the United States—again including the K.L.M.

Accessories

TO GENERALIZE on tendencies in airplane or engine design is difficult, but to generalize on accessories is plainly impossible. The term is wide enough to include the products of a dozen different industries having hardly anything in common with each other. To list the interesting or characteristic features of American accessory design and construction would be simply to construct a directory, and we have done that in the 22 pages that succeed this one. We have listed in detail the products and said something of the experience of well over 100 American manufacturers of aeronautical equipment of every sort. The operator of airplanes at home or abroad and also the manufacturer of planes and engines, even if he comes from a country with highly-developed aeronautical industries of its own, ought to find much of interest there. No one country, be it in America or in Europe, has evolved all the good ideas within its own boundaries. The industry of each nation can profit by purchasing from abroad some of the materials and accessories which foreign manufacturers may have introduced and have under monopoly control, or which they may be able to produce in a peculiarly high quality. In these introductory paragraphs we merely pick out a few noteworthy examples of results of American ingenuity and research applied to the development of accessories and list a few highly miscellaneous products in the development of which America played a conspicuously leading part.

Until the inertia starter appeared, the usual choice in starting an aircraft engine lay between cranking the propeller over by hand and installing a "gas starter" which was quite satisfactory for large multi-engined planes but much too heavy for the small military or sport types. The roll of cranking accidents, often fatal, was growing unpleasantly long. The energy of a spinning flywheel came to the rescue, and the danger disappeared from the job of starting, nor did it any longer require a special skill. The inertia principle, long since accepted as a standard in America, has been making steady though somewhat slow progress in other parts of the world. So too has the use of the direct-cranking electric starter, also common in American service, particularly on the larger planes.

The American industry has launched a profusion of wholly new ideas pertaining to landing gears. First came brakes, which had of course been tried from time to time all over the world but which were never produced in really satisfactory form and never acquired the status of standard equipment until American builders began to apply them in 1926. Soon after the appearance of brakes, and as a very natural consequence since it was no longer necessary to use the tail-skid to check the run along the ground, tail-wheels appeared on the market and began to replace the skids. Almost at the same time came the airwheel, followed by the succession of low-pressure and medium-pressure tires that have revolutionized landing gear design requirements over the past three years. Still another American novelty of more recent introduction has been the tire of streamline section.

At the absolute opposite extreme from landing-gear accessories are parachutes, for the brakes and tail-wheels can only be used when the machine is on the ground, while the parachutes are of no service unless there is a considerable amount of altitude. Given two or three hundred feet when incurable trouble develops, however, the parachute is the last resort and a very effective one, and the number of lives that have been saved by the caterpillar route now runs far into the hundreds. Aside from some seemingly very scattered use by the German Army during the War, the first use of airplane parachutes was made in America, and the American parachute is now regular equipment in the military services of more than 30 countries.

Miscellaneous airplane equipment, either originated or developed into its present form in the United States and remarkable either for high efficiency or for having gained wide popularity outside its home country, includes the directional gyro and artificial horizon as a blind-flying instrument, used on most of the notable long-distance flights of the last three years—the robot pilot first introduced by Lawrence Sperry twenty years ago and now, after much evolution and after use in Wiley Post's round-the-world flight, apparently at the point of readiness for routine commercial or military employment — the earth inductor compass, which has guided a number of trans-Atlantic aviators to their destination when they had no other navigation device—thermo-couple engine temperature indicators as warning devices for permanent installation on the instrument board—and the electric landing lights now being used in approximately 90 per cent of the world's commercial night flying. Ground lighting equipment also owes much to American electrical engineering and the experiments of the Army Air Corps, which created among other things the type of rotating searchlight beacon, slightly inclined to the horizontal, that has become the standard form of aerial light-house.

Of American airplane lighting Mr. Cathcart-Jones, the British private owner already quoted, says: "I found the wing landing lights more help than any other fitting I have ever seen, and it made landing by night easier than landing by aerodrome floodlight, due to the fact that the wing lights illuminated the actual part of the ground where the aeroplane landed, and could also be used to locate the windsock on the flying field quite independently of the aerodrome lighting. These landing lights provided an additional safety factor in the event of a forced landing at night, or when landing on a field not equipped with night landing facilities."

It would be possible to continue such a catalog as this almost indefinitely, but the foregoing are a few representative samples of the equipmnet that the aeronautical world has received from America and that American manufacturers are still quite ready to supply to all comers upon request. American aviation has had a great deal that is of value, both in the way of engineering suggestion and in the way of ingenious devices for importation, from abroad. This casual review, necessarily somewhat sketchy despite its having occupied ten pages, is our evidence that we are doing our best to hold our end up in the exchange and to offer the rest of the world something quite worthwhile in return.

AMERICAN AERONAUTICAL ACCESSORIES, MATERIALS, AND SUPPLIES

IN the May issue of AVIATION we published a directory of American aircraft and engines, with special reference to the background and the special interests of the companies that produced them. We now reach the second installment of a directory of American aviation, the section that covers the accessories and supplies and the specifically aeronautical materials.

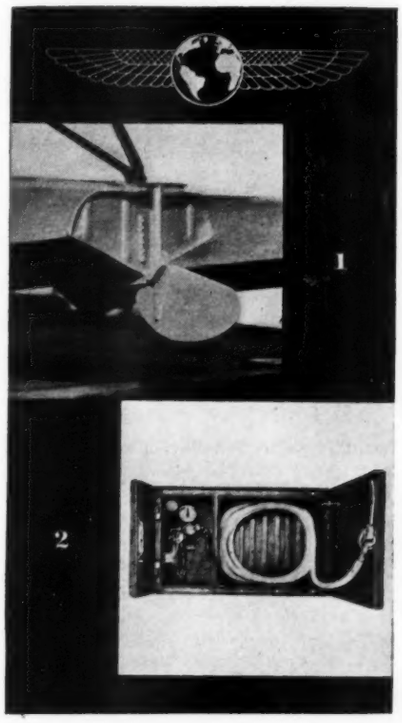
A directory of aeronautical accessories and materials spreads far afield. It covers the products of several dozen distinct industries, to some of which Aviation furnishes a sole and sufficient reason for being, while to others it is one among many interests. There is no pretense here, for there has been no attempt, of giving a complete listing of the companies that play a part in the aircraft industry (aside from the airplane builders and engine builders, already covered four months ago). We have in general limited ourselves in the pages that follow to enumerating the companies that have products specifically designed for aeronautical purposes and very largely used by builders and operators of aircraft. It makes quite an impressive list, and even those whose business it has been to stay abreast of aeronautical affairs (perhaps excepting the purchasing agents, who must make and keep their own directories of sources of supply) ought to find it interesting and perhaps a little surprising to canvass the field and see how many manufacturers of diverse interests have found it worth while making a special campaign against the aeronautical market. Even now, long as the list is, it is by no means complete. Some firms have been unwilling to make announcements at the present time, either because they have new products not quite ready for release or for some other reason, and others (though we hope that their number is small) have no doubt been omitted through oversight. Every attempt has been made, however, to make the record as full as possible within the boundaries that we have specified.

Of the firms included, many have already been active in the export field and their names will come to foreign readers of this World Market Issue as the names of old acquaintances. Others have not yet made any special quest for sales abroad, but might well do so. Practically all have been upon the market at home for a long enough time to have made some kind of a record of performance, and where the necessary information could be secured it is upon the record of performance that we have laid special stress. No story counts for more than the story of what has been *done*.

Edo Aircraft Corporation,
College Point, N. Y.

SPECIALIZING in the design and fabrication of all-metal seaplane floats and amphibian and flying boat hulls, the Edo company has no financial affiliations and has been under one management since its organization in 1925. Its factory is located on the southern shore of Long Island Sound, five miles from New York.

Altogether, Edo float gear has been flown on 106 different types of airplanes. Practically all commercial manufacturers in the United States are regular users of Edo equipment, and the U.S. Air Corps and U.S. Navy have been purchasers. Floats in twelve standard models are now regularly available in sizes suitable for ships ranging in gross weight from 1,000 to 6,400 lb. Colonel Lindbergh's Lockheed with which he has been conducting the Far North survey for Pan-American Airways is fitted with Edo floats. Numerous special designs have been turned out, one outstanding example being for the new Curtiss-Wright Condor (gross weight, about 17,000 lb.) Maj. Alexander de Seversky's new amphibian was built by the Edo Company. During the past year Edo floats have been supplied in some quantities for the European and South American markets. They are built under license by MacDonald Brothers Aircraft, Ltd., in Winnipeg, Manitoba, and regularly used by the Canadian Department of National Defense.



Designed for twin-float installations. Edo floats are of all-metal construction with the exception of sponge-rubber bumpers at the nose. Retracting water rudders are standard equipment. In use they operate directly from the rudder bars and are built so that they automatically fold up out of the water if they strike a floating obstruction, or during beaching operations. (Number 1)

Aqua Systems,
New York, N. Y.

HYDRAULIC flotation systems for use in handling gasoline, oil and other immiscible solvents are designed to secure elimination of evaporation losses and immunity from explosion resulting from escaping gas.

Aqua Field-flush Fueling Pits have been installed by the U. S. Army Air Corps, Royal Canadian Air Force, Curtiss-Wright Airports, Curtiss Aeroplane, Wright Aeronautical, Pratt & Whitney, Pan-American Airways, and other leaders in the aeronautical industry.

When installed in a concrete apron, the pit, which is made of heavy steel of welded construction, is flush with the surface of the apron. The covers are set low, lifting rings are inset, and there is no groove to interfere with tail-skids or tail-wheels.

Various models are manufactured for gasoline service and for lubricating oil, and a combined model for oil, air, and water service. (Number 2)

Bendix Brake Company, South Bend, Ind.

THE PURCHASE of civilian rights to a design of aluminum alloy disk wheel developed for the Army Air Corps by I. M. Laddon marked the beginning of the Bendix wheel and brake development in 1926. The application of the company's tremendously extended automobile brake experience to aeronautical problems led to the development of the Bendix airplane wheel and brake, of which some 30,000 have been produced and sold all over the world.

The wheel and brake business has progressed from the original series of plain bearing styles into the modern roller bearing types, and more recently into wheels for the low pressure tires now so popular. Lately, as a complementary development to the streamline tires originally brought out by General Tire and Rubber Company (see page 270), Bendix is offering streamline wheels conforming to the latest Air Corps specifications. All sizes required by the Army are now in production, including 24, 27, 31 and 40 in. The 21 and 36 in. sizes are being prepared for production, and a 50 in. wheel is in the experimental stage. (Number 3)

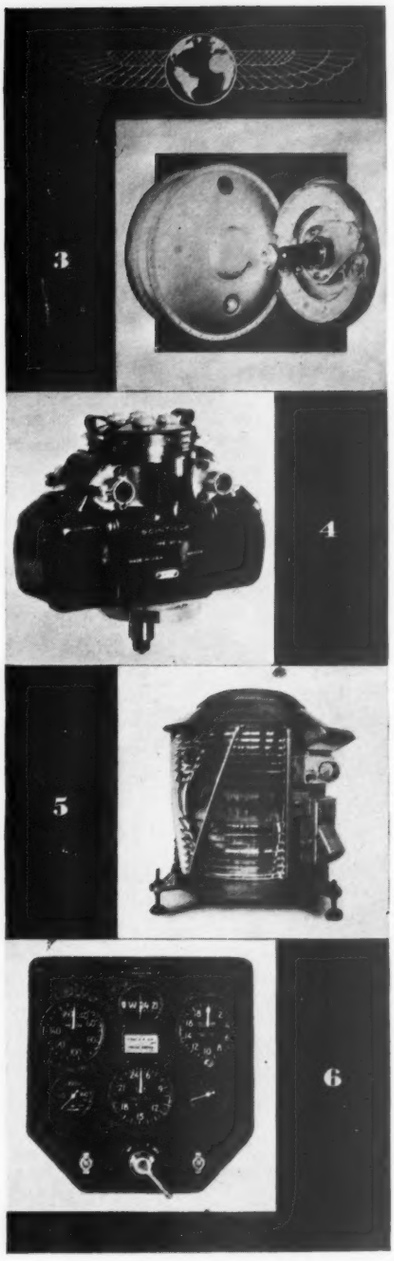
In the new brakes now under development the fundamental characteristic of the original Perrot-Servo brake has been utilized, but numerous modifications and improvements have been incorporated as a result of long experience in the automotive field. The outstanding feature is a flexible shoe which conforms closely to the surface of the brake drum when pressure is applied.

In addition to the wheels and brakes, a series of highly efficient shock absorbing struts has been placed on the market.

Recently Bendix has been developing a standard pilot's seat of extreme lightness to meet both Army and Navy specifications, and is preparing for production the latest Air Corps development—a streamline tail-wheel knuckle or swivel mounting provided with shock absorber attachments, and, in the smaller sizes, steerable.

Scintilla Magneto Company, Sidney, N. Y.

SCINTILLA aircraft magnetos, couplings and other ignition accessories are sold in the United States and are distributed elsewhere throughout the world by Scintilla, S. A., of Soleure, Switzerland, and its various branches and sales representatives. The V-AG series, probably the best known, is standard equipment for a large number of American radial aircraft engines, including Wright and Pratt & Whitney engines.



Scintilla N series magnetos are made in a variety of types for engines of one to 24 cylinders, and are available in three sizes for small, medium, or large engines. Double ignition from a single unit is provided by the magnetos of the SC series, each of which has a single drive shaft and rotating magnet but two coils and two breakers. The high-tension current is distributed to two independent sets of spark plugs through two separately mounted distributors driven at one-half crankshaft speed. These magnetos are available for practically every type of aircraft engine and can be equipped with radio shielding for use with any of the principal makes of ignition harnesses.

Scintilla magnetos have participated in the making of an enormous number of world's records, and an even greater number of sensational cross-country flights. (Number 4)

American Gas Accumulator Company, Elizabeth, N. J.

THE American Gas Accumulator Company acting in the capacity of selling agents for Sperry, BBT, as well as for AGA products, offers the aviation industry a complete line of airport lighting equipment. (Number 5)

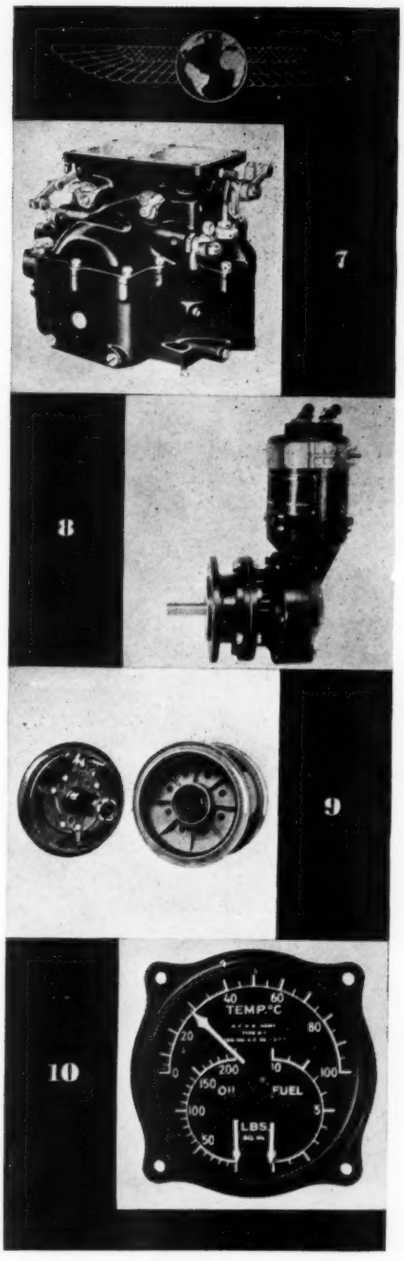
Among the items for aeronautical lighting are the Sperry-AGA-BBT 1000-mm. 180-deg. dioptric lens automatic arc and incandescent landing area floodlights, the 500-mm. 180-deg. dioptric lens incandescent floodlights, the 24-in. double-ended revolving beacon, the safety cone turnover type boundary light, as well as dioptric lens floodlights which have been developed for hangar interior illumination.

A patented self-locking nut (Elastic Stop Nut) is marketed by this company in a wide range of standard sizes and materials, and has found application in the construction of several new airplanes.

Aeromarine Instrument Company, Bronx, N. Y.

FOUNDED in 1932, the Aeromarine Instrument Company now produces a series of aircraft instruments, as well as instrument panel assemblies made up of their own equipment. The company is already represented in China, Japan, England and Germany.

Instruments are all put up in cases to fit Army-Navy standards, and can be furnished with either English or metric calibration. The complete line includes: (1) magnetic compass (similar to the Army B-8 type); (2) altimeter (calibrated either 20,000 ft. in one revolution or 15,000 or 30,000 ft. in 1½ revolutions); (3) tachometers (manufactured under the Jones patent, two styles ranging from 500 to 2,500 r.p.m., and 500 to 3,000 r.p.m. respectively); (5) fuel level gage (hydrostatic type); (6) supercharger pressure gages (10,000 to 20,000 ft.). (Number 6)



Bendix Stromberg Carburetor Company, South Bend, Ind.

WELL KNOWN for many years in the automotive industry and since 1929 a subsidiary of Bendix Aviation, the Stromberg unit manufactures a complete line of aircraft carburetors and offers them for all ranges of engines.

For the smaller types of radial and in-line engiens in the 50 to 450 hp. range, a series of single barrel carburetors designated "R", ranging in size from 1½ in. to 3 in., and equipped with accelerating pump, economizer, and needle valve type of mixture control, are manufactured. Double barrel carburetors for use on engines in the 400 to 850 hp. range are also listed, and used extensively in America. The NA-Y7B is the smallest in this class, while the larger models are the NA-Y8C, NA-Y8E, and NA-Y9A, all similar in design but different from the NA-Y7B. A down-draft carburetor, designated NA-U8G and suitable for use on engines of 600 to 700 hp., is also available, and includes an accelerating pump and economizer. (Number 7)

Eclipse Aviation Corporation, East Orange, N. J.

ECLIPSE PRODUCTS, principally for engine starting and generating electrical current for various purposes on board aircraft, are being widely used in commercial and military services both at home and abroad. Licenses for the manufacture of the starting equipment have been granted to companies in England, France, Germany and Italy. Eclipse electrical equipment, to meet requirements abroad, is designed for operation on 24 volt two-wire system as well as 12 volt which is used in America.

Three distinct types of starting equipment are offered. First, the inertia starter is available in units applicable to engines of either rotation ranging from 175 to 800 hp., energized either by hand or electric motor or both. Certain airlines, to avoid the drain on the airplane storage batteries by the starter before take-off, have adopted Eclipse external cranking devices drawing power from ground lines to "wind-up" the inertia starters. Auxiliary equipment for the inertia type of starter such as solenoid switches, meshing devices, battery booster coils, integral booster magnetos, etc. is available.

The second type of starter is the electric direct cranking, close kin to the conventional automobile starter. Units are manufactured in either 12 or 24 volt for use on engines up to 700 hp.

A third type of starting equipment which has proven very popular, especially in Europe, is the hand turning gear. Simple in design and light in weight it can be used on engines up to approximately 300 hp. Models are available with or without booster magneto.

In addition to starting equipment, Eclipse manufacture a complete line of 12- or 24-volt generators for battery charging and lighting as well as various capacity dynamotors for use as power for radio receiving and transmitting.

Reversible, light weight motors are also built for the operation of the retractible types of landing gear. A recent addition to the line of accessories has been the engine driven air pump which can be used as a vacuum or pressure source. (Number 8)

Automotive Fan & Bearing Company, Jackson, Mich.

LANDING WHEELS, brakes, and tail-wheel constitute Automotive's aeronautical output. Autofan airplane wheels and brakes for low-pressure tires are of the self-energizing type. These products are used on all of the Stinson Junior models as well as on the tri-motor Model U, the Curtiss P-6E pursuit plane, the Consolidated Trainer, and on various models of Bellanca, Kellett, Kinner, and others. (Number 7)

The 12.50-14 and the 15.00-16 size wheels can be furnished with hydraulic brakes in either aluminum alloy or magnesium alloy (Dowmetal). Sizes in the standard models range from 7.00-5, with 1,000 lb. capacity per wheel, to 15.00-16 with 7,000 lb. capacity. Tail-wheels, in sizes 10x3, 5.00-4, and 7.00-5, with capacities of 325, 500, and 700 lb., respectively, also are available.

A complete line of newly designed streamline wheels, equipped with the latest type of mechanical and hydraulic brakes, is also offered. Wheel sizes range from 15 to 50 in. outside diameter, with capacities of 250 to 10,000 lb. per wheel. Streamline tail-wheels too, are available in several sizes.

Consolidated Ashcroft Hancock Company, Bridgeport, Conn.

THROUGH a succession of mergers and combinations the Consolidated Ashcroft Hancock group was formed. Today the American Schaeffer & Budenberg Division of the company handles the aircraft instrument work which was started in 1927 and is mainly concerned with thermometers and pressure gauges and combined instruments for the Army and Navy.

The engine gauge unit combines in a single case of standard size, with a standard 2¾-in. dial, an oil temperature gauge, and fuel and oil temperature gauges. The instrument is marked either for English or metric units, and metric threads can be supplied if desired. Among their other products are standard dial-type thermometers and pressure gauges, as well as a dial-type strut thermometer. (Number 10)

The B. G. Corporation,
New York, N. Y.

SOME fifteen years ago, B.G. put upon the market a series of spark plugs designed specifically for aviation engines, independently of automobile requirements. In 1926 the advent of radio in aircraft introduced new problems for the spark plug manufacturer. The B.G. Corporation set about an intensive research on the problem, and today its mica insulated spark plugs, both shielded and unshielded, are in active service on every airline of this country and many of those abroad. The plugs manufactured under license in France by La Bougie B.G. are exactly similar to those made in New York except that the hexagon and the terminals are made to conform to the metric standard prevailing in Europe. B.G. plugs have also played a part in many sensational flights, including Post's recent world trip.

The standard unshielded plug is made up in two parts which can be readily disassembled for cleaning. The electrode is mica insulated, and the shell is provided with four sparking points. It is comparatively small in size, 2 in. high and weighing 1.32 oz. The hexagon conforms to S.A.E. standards for "midget" aviation spark plugs.

In the shielded series the shielding is inherent in the design of the plug and is not obtained by the application of external attachments. Various kinds of elbows can be interchanged on the plugs to make connection with the different varieties of shielded ignition harnesses commercially available. They are equally applicable to the standard shielded wires manufactured to make connections with various forms of external braiding. (Number 11)

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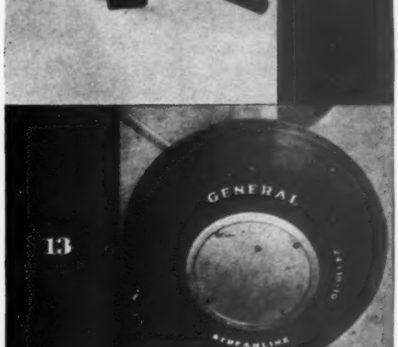

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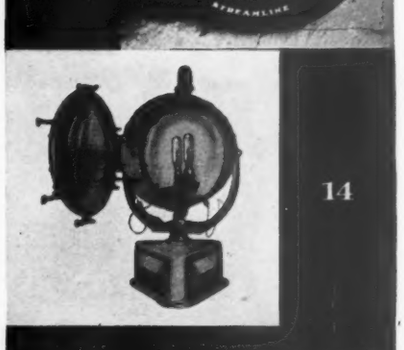
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Fairchild Aerial Camera Corporation,
Woodside, N. Y.

ORGANIZED shortly after the close of the World War by Sherman M. Fairchild, this company has specialized in the development, design and manufacture of aerial photographic equipment for military and commercial purposes. It is the policy of the Fairchild organization to develop a different type of camera for each type of aerial photography in order to obtain a greater degree of perfection than is possible when a general purpose type is developed for a number of different applications. Each camera is made up of standardized units and complete interchangeability has been obtained without sacrificing the necessary precision in any degree. Fairchild cameras are standard equipment for both United States Army and Navy aviation services, as for many foreign governments.

Type T-3A, the latest Fairchild development, is a 5-lens camera for mapping purposes, military or commercial. It was described in some detail in AVIATION for July, 1933. The model K-3B is the basic camera of the United States Army Air Corps and is equally well suited for use as an automatic camera for taking overlapping vertical photographs or as a hand-held camera for taking oblique pictures. The K-8 is somewhat similar to the K-3B except that this camera type has provision for automatically recording all pertinent data (time altitude, etc.) on each negative. This camera, unlike the K-3B, is not suitable for oblique photographs. A smaller model, the F-8, is designed primarily as a hand-held aerial camera.

The latest Fairchild development, the Type CG16 camera machine gun for military training uses a 16 mm. film in magazines which can be loaded into the gun as simply as a clip of cartridges into an automatic pistol. (Number 12)

Complete developing and special printing equipment, both for contact and rectified prints, are also included in the regular Fairchild line.

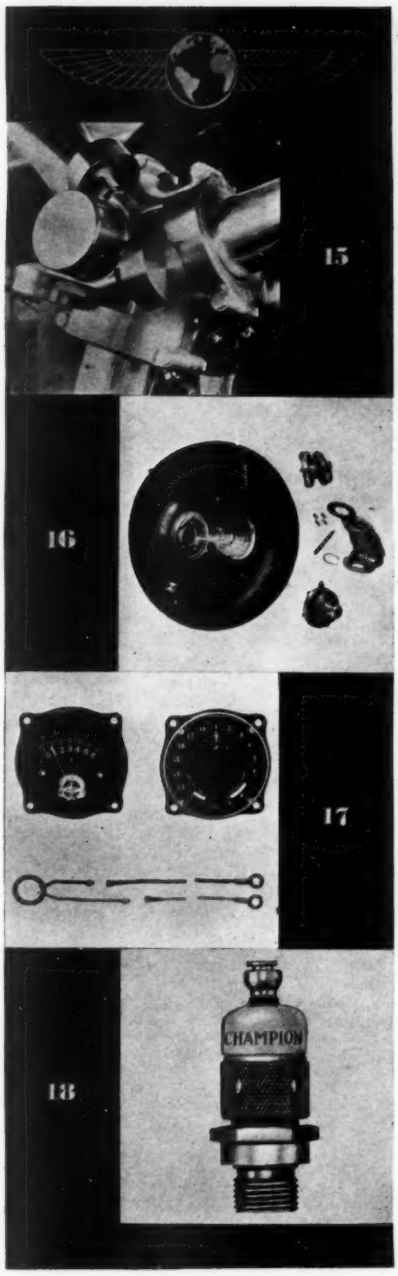
General Tire & Rubber Company,
Akron, Ohio

AMONG its tire and tube products introduced during the last two years General has included a series of streamlined tires for airplanes. Parabolic in external shape, the object is to reduce wheel drag without the necessity of "pants" or other coverings. Sizes available cover the entire range of the standard models they are designed to replace, and also include the common tail-wheel sizes. As a result of extensive tests by the Army Air Corps, and with the cooperation of the tire manufacturers, a new series of streamlined wheels and brakes has been developed to accommodate the General tires. (Number 13)

Crouse-Hinds Company,
Syracuse, N. Y.

FOUNDED in 1897 to do a general electrical manufacturing business, Crouse-Hinds specialized in its early days in small switches, panelboards, and trolley-car headlights. Later, experience with trolley-car headlights and with various types of floodlights and traffic signals was easily translated to the needs of airways services.

During the last few years Crouse-Hinds has supplied to the Airways Division of the Department of Commerce some 550 beacons (400 of the original 24-in. size and 150 of the newer 36-in. size) and many "on-course" lights and ceiling light projectors and indicators. To the general public there is available a complete line of lighting material for airports, including rotating beacons, code beacons, field floodlights, boundary lights, obstruction lights, wind-cone fixtures, and flush-type marker lights. (Number 14)



Hamilton Standard Propeller Company, Hartford, Conn.

PROPELLERS by Hamilton Standard are being used on practically all ships of the United States Military Services and those of a great majority of the transport operators. They have taken part in most of the famous long-distance flights, including those of Colonel Lindbergh, Admiral Byrd, Post and Gatty, Amelia Earhart and many others. Large numbers are in use in Europe, notably on the Amsterdam-Batavia Line of K.L.M. They have been purchased in quantity by Russia, China, Japan and many South American countries.

In addition to the standard two- and three-blade adjustable pitch types, with forged duralumin blades set in forged steel hubs, the company has lately undertaken to supply controllable pitch propellers. These controllables are hydraulically operated and are all of the two-position types, that is, the variation is directly from a fixed low pitch (or take-off and climb) to a fixed high-pitch (or cruising) setting. The range of controllability is adjustable on the ground. A full description was published in the March, 1933, issue of AVIATION.

Recently a three-bladed controllable of the same general type has been successfully test-flown, and has been approved for engines up to 725 hp. United Airlines are fitting all of the new Boeing transports with the two-bladed controllables (for discussion of their performance with the controllable-pitch propellers, see AVIATION, June, 1933). A number have also been used on the Pan American System, on Swissair, K.L.M., Luft Hansa, and many other lines abroad. (Number 15)

Goodyear Tire & Rubber Company, Akron, Ohio

APPROXIMATELY one-third of the airplanes now operated in the United States are reported as equipped either with the Airwheel tires and tubes or with the wheels and brakes of the full-balloon or extra-low-pressure type which now constitute the principal heavier-than-air business of the Goodyear company. In addition, the company manufactures a complete line of high pressure tires and tubes and popular sizes of intermediate or semi-low pressure types. Goodyear has been active in aeronautics for more than twenty years, the first catalogue of airplane tires having appeared about 1909.

Goodyear Airwheels are used in almost every country in the world. In addition to exporting a large quantity of these products from the Akron plant, the Goodyear Tire & Rubber Company of England has added facilities for their manufacture.

Within the past few months Goodyear has announced its new hydraulic brake (see AVIATION April, page 129), a radical departure from airplane brake design. It is built on the multiple metal disc principle and provides ample braking area. It is not self-energizing and has no tendency to grab. These new brakes have been tested by the Army, by several air lines and by a number of airplane manufacturers, and they have successfully met the most rigid operating specifications. (Number 16)

Lewis Engineering Company, Naugatuck, Conn.

A NUMBER of Lewis temperature indicating units are now in service both in this country and abroad. The following are offered: (1) Aircraft temperature indicators (thermocouple type only), internally compensated, Navy standard cases, calibrated for either copper-constantan or iron-constantan couples; (2) thermocouples and thermocouple leads; (3) rotary multiple switches with silver-plated contacts, especially designed for use with thermocouples to select the cylinder for which the reading will be taken; and (4) portable potentiometers designed to operate under conditions of heavy and intermittent vibration. (Number 17)

Champion Spark Plug Company, Toledo, Ohio

ENTERING the aviation field nearly a decade ago, Champion began the development of a spark plug specially fitted to the performance needs of airplane motors. For many years prior they had been manufactnring spark plugs for automotive and boat service.

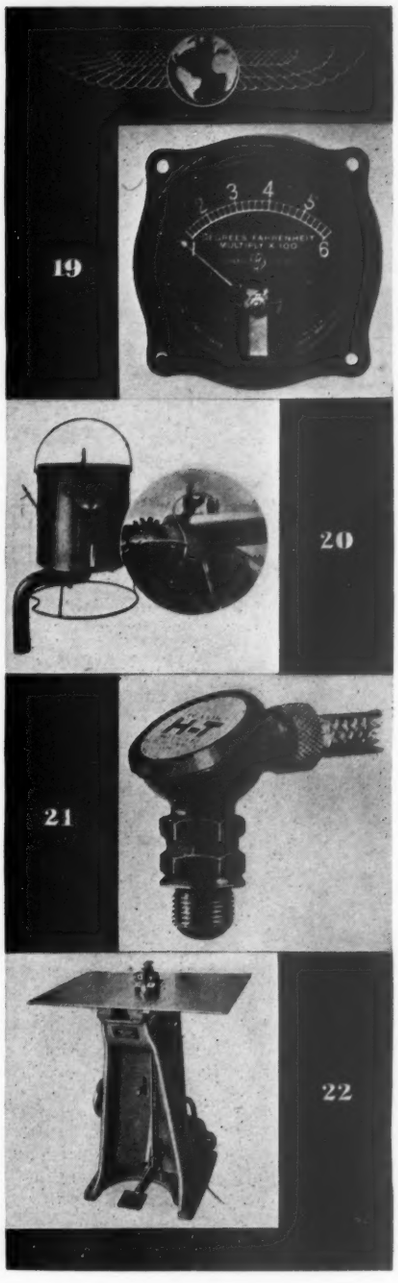
The two types of plugs now recommended for aviation are the A and the RA. The RA has a radio dome shield, offering protection against shorting caused by dirt, rain, ice, or oil, and grounded to eliminate radio interference.

The restricted bore enables the Aero RA to be used in practically all radial air-cooled and high-compression liquid-cooled engines.

This plug is made up of two units—the shield assembly and the base (plug) assembly. Either can be bought separately as needed.

For testing old spark plugs, the manufacturer has placed on the market a new instrument for testing plugs under compression corresponding to operation in the engine.

Prominent among the aviation feats in which Champion spark plugs were part of the equipment were the first trans-Pacific Flight by Clyde Pangborn and Hugh Herndon in 1932, Capt. Lewis Yancey's hop to Havana in an autogiro and Francesco Agello's in setting the new world's speed record of 426.5 m.p.h. Number 18)



General Electric Company, Schenectady, N. Y.

LONG-TIME MANUFACTURERS of electrical equipment of all kinds for all industries, General Electric impinges upon the aeronautical field at several important points. Perhaps its most important contribution has been in the supercharging of aircraft engines for work at high altitudes. As an outgrowth of years of experience in high-speed turbine design, General Electric engineers produced late in 1918 the first exhaust-driven rotary supercharger. With the development of radial air-cooled engines the results of the work for the Air Corps were translated to the commercial field, and today the majority of the radials in service and commercial use in the United States are equipped with General Electric type superchargers. Practically all of these later types are gear-driven.

In addition to the supercharger work General Electric has also produced many aircraft instruments, among them the magneto compass, several magnetic compasses, and a number of temperature indicating instruments such as the thermocouple pyrometers used to read cylinder head temperatures directly on the instrument board. Within the last few years much work has been done, too, on a sonic altimeter to give accurate altitude indications under 1,000 ft. as an assistance to blind landings. The sonic idea has also been tried out for marker beacon service. Bayonet-type electric heaters have been used for preheating aircraft engine lubricating oil, and a number of other GE tools and products find usage in maintenance shops and manufacturing plants. (Number 19)

Gilbert and Barker Mfg. Company, Springfield, Mass.

THE "Filter Funnel" has been used to filter the gasoline for many trans-Atlantic planes, such as Coste & Bellonte's "Question Mark", and Boardman and Polando's "Cape Cod", which flew non-stop to Turkey. Made especially for aviation fueling service, the Filter Funnel separates foreign matter, dirt, sediment and water from gasoline, and, although it has a capacity of 25 gal. per minute it is small enough to be handled conveniently by one man. A gage glass in the side of filter indicates any presence of water in the gasoline, and a quick-draining petcock and a shut-off valve are features.

The "Aero Pit" is another product by this company, for use in fueling on the line. The pit is built of heavy gage steel plate with welded seams. Like the funnel, it has a normal feeding capacity of 25 gal. per min. (Number 20)

Hurley-Townsend Corporation, New York, N. Y.

ARRANGEMENTS have been completed recently with Scintilla A. G. for the world manufacturing rights (outside the United States) to the HT spark plug. The Scintilla product to be manufactured in Solothurn and Paris is to be an exact duplicate of the American copper-cooled HT design and will be distributed through the 200 Scintilla agents located in practically all countries of the world.

The HT copper-cooled spark plug is distinctive in that the mica insulation is wound over a copper tube which fills a dual purpose, transmitting the heat away from the nose of the plugs to prevent burning of the electrodes and also securing extreme gas tightness for the entire length of the core. Another feature of this plug is the closed-in shell, in which the combined area of three vent holes is greater than that of the spark-gap surrounding the central electrode, yet sufficiently restricted so that on the compression stroke some of the first gas is forced through the spark gap. This assures freedom from carbon deposit within the plugs and blows away oil or condensed moisture, so making starting easy at all times. In addition to the regular model, the HT plug is also made with a radio shield. This shield becomes part of the regular harness of the motor, and new replacement plugs are available to fit into the shield. (Number 21)

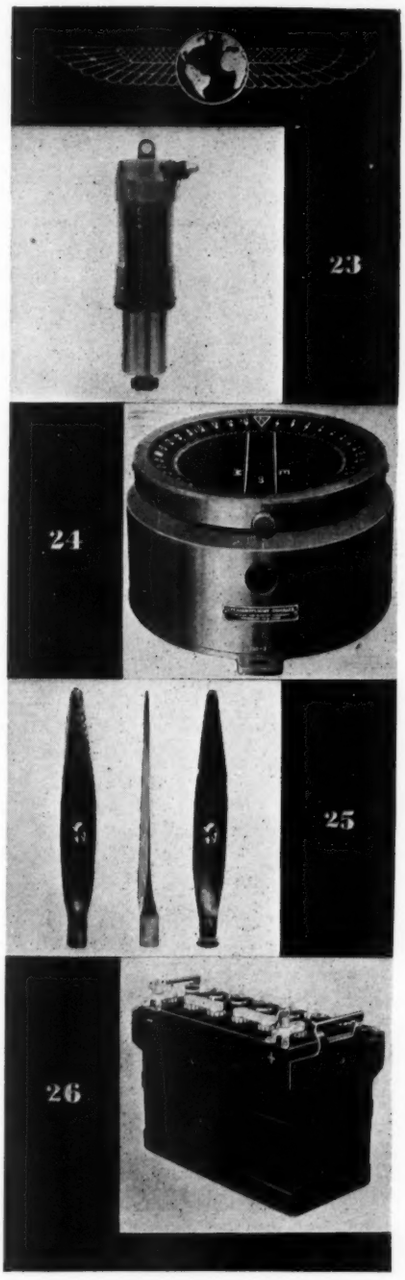
Engineering and Research Corporation, Washington, D. C.

TO ELIMINATE the tremendous investment involved in forming dies and machinery the Engineering and Research Corporation has concentrated on the design and development of a sheet-metal former lending itself to a large variety of uses. It is capable of flanging any sheet metal that can be hand-worked without fracture, internal strain, or gauge reduction. It requires no forms, dies or templates, and it can be used to make internal or external flanges on products of any length, straight or curved, with flat or crowned stock.

The model LD sheet metal former will handle all sheet metal up to steel 1/16 in. thick. A large model capable of flanging to a maximum height of 2 in. is now in production. This is made in both light and heavy duty types, the lighter one will handle soft metal up to a thickness of $\frac{1}{8}$ in., while the maximum capacity of the heavier type is 3/16 in. steel.

A new punching and riveting machine has more recently been put on the market with a throat depth of 36 in. It will handle solid or tubular rivets from 3/32 in. to $\frac{1}{4}$ in. in diameter, and up to 1 in. long. It will punch a hole thru mild steel sheets of a thickness equal to the diameter of the rivet.

Formers and riveters have been sold in England, Germany and South America. (Number 22)



Cleveland Pneumatic Tool Company, Cleveland, Ohio

A FIRM BELIEF in the future possibilities of the aicraft industry long ago caused the Cleveland Pneumatic Tool Company to turn its attention to landing-shock-absorbing devices for use on aircraft. It has taken an active interest in the promotion of flying through the National Air Races, sponsoring the Aerol Trophy closed course race for women.

The company specializes on the manufacture of oleo-pneumatic, oleo-spring, and straight pneumatic types of landing gear. This equipment is made up in sizes suitable to airplanes weighing from 740 lb. to 26,000 lb. gross. Aerol struts and pneumatic tools, couplings and fittings of Cleveland manufacture have been furnished to many American manufacturers, including Grumman, Bellanca, Northrop, Stinson, Curtiss, B/J, and Consolidated, also Stearman, Beechcraft and Gee Bee. The government air services as well as the transport lines have been extensive users. Special types of Cleveland shock-absorbing struts were incorporated in the gas cell supports of the Akron and the Macon. (Number 23)

Pioneer Instrument Company, Brooklyn, N. Y.

SINCE 1919, Pioneer has specialized in the production of navigating and control instruments. In 1929 the company became a unit of Bendix Aviation.

Pioneer Instruments are found on all domestic and on many European commercial transport airplanes. In addition, a large percentage of Pioneer equipment is found on the instrument boards of many foreign military planes. Instruments are made under license in Japan, France and Italy. Besides sales agents located in almost every country of the world Pioneer maintains a general European representative (in Paris) and a general South American agent.

Pioneer instruments, built to conform with Army-Navy standards, are ordinarily calibrated in U. S. standard units, but may be furnished with markings to conform to any foreign requirement. The principal products are:

Air distance recorders; air speed indicators (fixed and rotatable dials); pitot and venturi tubes; altimeters (with barometric correction); bank indicators; climb indicators; clocks; magnetic compasses (panel or bracket mounting types, also aperiodic styles—"Straightway" and "Straightflight"); drift indicators; fuel gages; navigating instruments (octant, etc.); fuel and oil pressure gages; supercharger gages; tachometers (magnetic, centrifugal and electric); thermometers; turn and bank indicators; and voltmeters and ammeters. In addition to the line of instruments a number of important accessories are produced, including such items as parachute flares, instrument-board lights, switches, terminals, etc. (Number 24)

Pittsburgh Screw & Bolt Corporation, Pittsburgh, Pa.

SEVERAL YEARS AGO this company became interested in the manufacture of Dicks hollow steel propeller blades and took over the development of the type. Pittsburgh steel blades were used in conjunction with a Smith controllable-pitch propeller hub by Wiley Post in his recent record-breaking flight, and also by Doolittle in breaking the world's speed record last year.

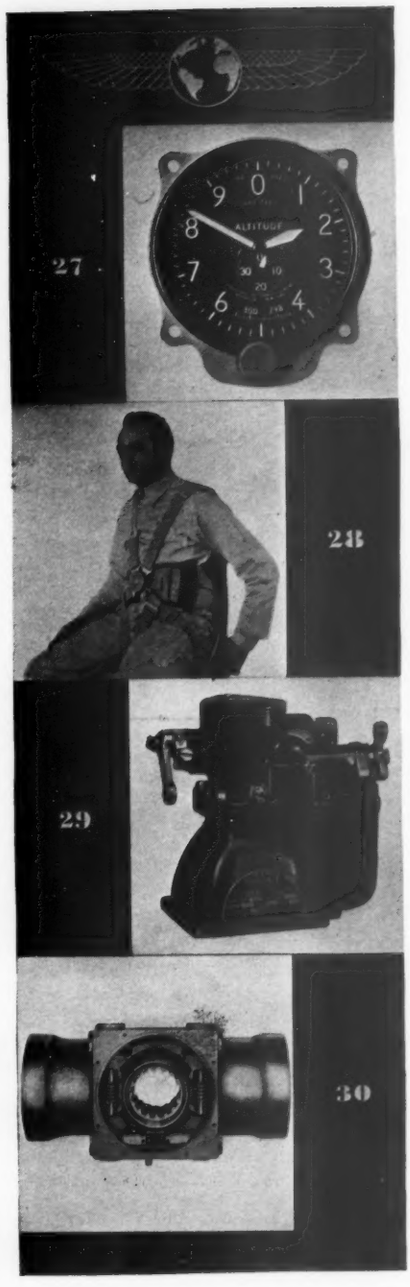
For nearly three years Dicks hollow steel blades have been in flight service in the Army and Navy air forces, and several hundred blades have stood the test of many hundreds of hours of use. The manufacture of blades for propellers up to 18 ft. in diameter for naval lighter-than-air use has been arranged, and blades are also being made for the Navy's largest seaplanes.

In commercial work on several transport lines it has been found that because of the resistance to the detrimental effects of salt water, sand, gravel and cinders, maintenance costs on these blades have been very low. (Number 25)

Electric Storage Battery Company, Philadelphia, Pa.

THE company has had a background of 45 years of experience in the manufacture of storage batteries for every purpose, and from the first days of the airplane industry Exide engineers have devoted their energy toward the production of a battery suitable for the specialized conditions of aviation service. One of the most representative of the Exide line is the Type TX-19, designed to handle all lighting loads, radio, starting and ignition. Batteries for all purposes, not only for the transport lines but for private airplanes as well, are available in a number of sizes and types.

A special feature of the Exide aircraft battery is a compartment above the plate to hold all of the electrolyte when the battery is inverted. Special non-spill vent plugs are provided, having hollow tubes several inches long projecting into the cells. For starting, lighting and ignition purposes, Types TX (9, 13 or 19 plate, 2, 6 or 12 volts) and TS (7, 13 or 25 plate, 6 or 12 volt) Exides are provided for use with or without a generator. Multiple units of 12-volt batteries provide higher voltage systems for lighter-than-air craft. For ignition service alone, two sizes of Type AC Exide batteries (7 or 11 plates, 2, 8 or 12 volt) are available for use when generating equipment is carried. (Number 26)



Kollsman Instrument Company, Brooklyn, N. Y.

SINCE 1929, when it was first introduced, the Kollsman sensitive altimeter has found wide use. With the exception of gyroscopic devices, Kollsman today manufactures a complete line of navigating and engine operating instruments.

First of Kollsman altimeters is the normal type, with a single indicating hand. It is regularly finished with barometric pressure correction in ranges up to 10,000 ft., 20,000 ft., and 40,000 ft. as well as in corresponding metric sizes. The sensitive-type altimeters are readily distinguished by the fact that they carry two or more hands, a large one to make one rotation around the face of the dial for every 1,000 ft. of altitude and smaller ones usually arranged for one complete revolution for every 10,000 ft. The scale easily shows differences of elevation of 10 ft. Metric readings on these instruments are also available. The regular instruments are in the standard 3⅛-in. case, but a special type in a 6-in. case has been developed where extreme accuracy of indication is required.

Beside the altimeters, the Kollsman line includes supercharger pressure gages; a triple engine gage unit incorporating engine temperature indicator, oil pressure gage and fuel pressure gage in one 3⅛-in. standard diameter mounting; remote-indicating fuel-level gages of a simplified hydrostatic-pressure-cell type; temperature indicators of all types for engine oil, water, cabin, or ice warning; air-speed indicators of the pitot-tube type, and finally, two styles of magnetic compass, both in active use by the United States Navy. Among the most recent developments is a special compass compensator, very compact and easy to adjust. (Number 27)

Irving Air Chute Company, Buffalo, N. Y.

LONG IN USE by the military forces of the United States, Irvin Air Chutes began to penetrate foreign markets in 1924. Extensive use abroad soon necessitated the establishment of a factory in England. At present Air Chutes are used by 36 governments throughout the world. Nearly 800 lives have been saved. All but five of the 36 countries have at least one name on the Caterpillar roll.

While the fundamental design of the Irvin Air Chute has never been altered, many improvements and refinements have been made. The standard seat-type remains the accepted type for general military service use. The back and lap types also have their applications to lighter-than-air and observation aircraft respectively, although the latter has been replaced to some extent by the quick-connector type which permits carrying the pack separately and wearing only the harness in flight, leaving gunners and photographers free of encumbrance while in action.

The new quick-release harness can be adopted to all Irvin packs except the lap type. It accomplishes its purpose by a convergence of harness straps into a specially developed quick-releasing fitting. This harness is now a British Air Ministry standard for service activities, and it has also been exported to twelve other governments now considering its adoption for all marine operations. (Number 28)

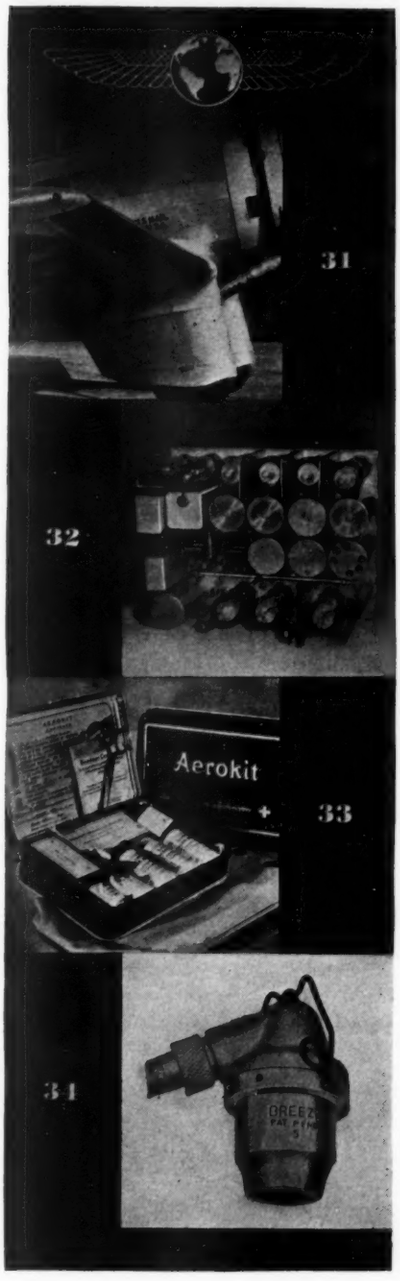
Holley Carburetor Company, Detroit, Mich.

IN THE CARBURETOR BUSINESS since 1905, Holley has supplied equipment for all types of automotive engines—automobile, power boat and airplane. Gar Wood used Holley down-draft carburetors in breaking world records on the water recently, and a number of aircraft engine manufacturers (incl. Kinner and Warner) mount Holley carburetors. Single-barrel models are manufactured in sizes 1½ in., 2 in., 2½ in., and 3 in. Double-barrel models run 2½ in. and 2¾ in. These carburetors are all of the usual jet type, float-controlled, and are regularly equipped with an accelerating pump, power jet, and manually-operated mixture control. (Number 29)

Smith Engineering Company, Cleveland, Ohio

IN 1931, after several years of development, a controllable-pitch propeller was tested and approved by the U. S. Army and Navy. Up to the present time the Smith company has furnished controllable-pitch propellers also to the Royal Italian Air Ministry, the British Air Ministry, Royal Dutch Air Lines, and other European organizations, in addition to its domestic activities. Smith propellers have been used on notable flights, including Wiley Post's recent round-the-world trip, and Doolittle's high-speed work which resulted in setting the present landplane record.

While the Smith company is in a position to supply the complete propeller units (two or three bladed), it is concerned mainly with the manufacture of controllable-pitch hubs fabricated from heat-treated chrome-vanadium steel. The system of gearing provides a ratio of 18,000 to 1 and a possible pitch change of approximately 0.5 deg. per second. An infinite number of intermediate pitch positions are available between the maximum and minimum settings. The blades remain in synchronism at all times, and under no conditions will the pitch change without definite action on the part of the pilot. These propellers are available in two- or three-blade types. (Number 30.)



The B. F. Goodrich Company, Akron, Ohio

WITH the growth of the aeronautical industry, Goodrich (manufacturers of rubber goods since 1870) early turned its attention to rubber products for aircraft use. The most natural approach was through tires and tubes for landing wheels, and Goodrich aircraft tires have for many years been available and widely used, in all the standard sizes.

Several years ago an exhaustive study was commenced on the problem of the prevention of ice formation on aircraft, and, as a result, the Goodrich de-icer or "overshoe" has emerged as a practical method of control. Overshoes are applied to the leading edges of wings and tail surfaces. Impregnation of the rubber by special oils and chemicals reduces the adhering power of ice to the surfaces, and alternate inflation and deflation of the tubular "overshoes" by compressed air break up the ice already formed and permits the air stream to blow it away. A secondary application of the same type is the so-called abrasion shoe, which fits on wings and surfaces in much the same manner as the de-icer but is not equipped for pneumatic inflation. (Number 31.)

Western Electric Company, New York, N. Y.

AS FAR BACK as the World War Western Electric (makers of electrical equipment since 1869) manufactured airplane radio receiving sets. Continuous experimental work in conjunction with the Bell Laboratories during the following decade culminated in 1929 in the first public demonstration of Western Electric equipment for two-way radio communication between airplane and ground for commercial service.

Western Electric products are available in Canada and in all other foreign countries. Installations of aircraft radio-telephone equipment have so far been made in Spain, Italy and Manchuria. In the United States Western radio telephone equipment has been adopted by many outstanding airlines.

The communication equipment for aircraft manufactured by this company may be summarized as: (1) Complete two-way radio telephone equipment and beacon receivers, with quartz-crystal-controlled superheterodyne receiver and 50-watt transmitter, and intermediate-wave receiver arranged for either aural or visual indication, all sets operated by remote control from the cockpit; (2) complete ground station equipment (400-watt transmitter and short-wave superheterodyne receiver); (3) short range (25 mi.) transmitters (Model 10A) for airport traffic control duty (10-watts, operating in weather broadcast frequency range); (4) two-way radio-telephone equipment for the itinerant or private flyer, incorporating a short-wave transmitter and intermediate-wave receiver for both beacon and airport transmitter reception, and having the same basic features as the transport plane design, but lighter and more compact; (5) public address system for airports, making announcements audible one mile from the source under normal conditions. (Number 32)

Johnson & Johnson, New Brunswick, N. J.

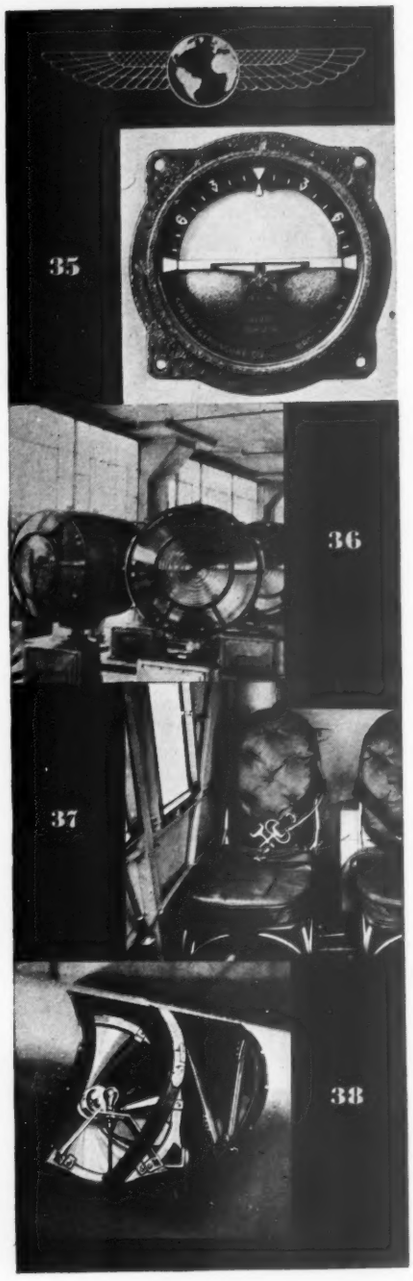
FOR MANY YEARS manufacturing medical equipment and supplies, an important recent product is a medical kit to meet the Department of Commerce approval for airplanes. The kit is stowed in a metal box 7.5 in. by 5 in. by 1.75 in. weighing 1 lb. 5 oz., and the box goes into a heavy tan canvas cover, furnished with a loop so that it can be worn on a belt, hung up or fastened to a wall. Within the case are a variety of bandages, cotton, adhesive plaster, aromatic spirits of ammonia, antiseptics, aspirin, a tourniquet, and scissors. (Number 33)

Breeze Corporation, Newark, N. J.

ALTHOUGH other aeronautical products have been added since Breeze entered the aviation field 10 years ago, flexible metal air hose still constitutes one of the company's principal aviation products. It is available in sizes ranging from that required by the intake of the largest carburetor down to very light small-diameter hose designed for use with aircraft instruments on flexibly mounted boards. It may also be used on exhaust lines.

Increasing demand for radio shielding furnished a new outlet for flexible hose. Breeze went into the business, and now has available complete shielded ignition systems, from magneto housings to spark plug "cans," for all American engines of 300 hp. or over and for many of smaller size. A complete line of conduit and fittings for all types of wiring aboard aircraft is also available. Additional products are: Aeroflex fuel and oil lines and fittings; radio-shielded battery containers for all A-N standard batteries, tie-rods, both in ordinary and stainless steels, for internal and external applications (a true streamline wire is now under development); flexible shaft drives for tachometers, etc.; an ignition synchronizing device to check the timing of a two-magneto or twin battery system; and a new line (about to be announced) of improved navigating and running lights for aircraft.

Breeze products have been sold in Switzerland, France, China, Japan, Czecho-Slovakia, Turkey, and in most South American countries. The company of America in 1907. Present head-France and Cuba, and markets elsewhere through agencies. (Number 34)



Sperry Gyroscope Company, Brooklyn, N. Y.

THE NAME of Sperry has been associated with the manufacture of aircraft accessories for many years. Recently the efforts of the Sperry company have been concentrated entirely on instruments involving gyroscopes. The Sperry horizon is designed to give the pilot a dependable reference line from which to fly when the natural horizon is obscured. The directional gyro is an adjunct to the compass, carrying a circular card graduated in degree to show the relative movement of the airplane in azimuth. The basic element of both instruments is a small gyroscope driven either from venturis or from vacuum pumps. These instruments contain no electrical equipment and no parts subject to magnetic influences. Balbo's squadrons were equipped with horizons and directional gyros. (Number 35.)

The latest development is a new automatic airplane pilot built around the basic elements of the horizon and the directional gyro. Very effectively used by Wiley Post in his recent round-the-world flight, it is now being tried on several well known airlines.

Recently Sperry engineers have penetrated a new field,—the soundproofing of airplane cabins. An outstanding job was done on the 1933 Curtiss Condor and other new transport designs are being studied.

Westinghouse Electric & Mfg. Company, East Pittsburgh, Pa.

A MANUFACTURER of long standing of electrical and other devices for the transportation industry, Westinghouse has naturally taken an active part in the development of materials and equipment for aviation use. Among equipment recently furnished to the Department of Commerce have been some 250 double beam beacons 36 in. in diameter, visible normally for more than 50 miles.

The entire lighting installation of the new Allegheny County airport at Pittsburgh was planned by Westinghouse engineers and includes some 25 items of the company's products, such as boundary and obstruction lights, marker lights, floodlights, revolving beacons, illuminated wind cones, searchlights and traffic control lights. Westinghouse also builds ceiling projectors and alidades as well as signalling searchlights. Various items for the shop are also available.

Micarta has been widely used in sheet form for interior panelling in aircraft cabins, and also in molded form for control pulleys and guides. Another accessory of recent origin is the electric fuel valve, a device to shut off the supply of gasoline at the main tank when the ignition switch is cut; purpose: to reduce fire hazard in crashes. (Number 36)

Switlik Parachute & Equipment Company, Trenton, N. J.

FOUNDED by Stanley Switlik in 1903, first among the strictly aeronautical products to be manufactured were pilot belts, flying clothing, and wind cones. Several years ago the manufacture of parachutes was taken up, and at the present time the line includes 24 types, all approved by the Department of Commerce.

Switlik parachutes are used extensively by the Army and Navy and were selected by Frank Hawks and Wiley Post for use in recent record flights. A number of sales have been made to South American and other foreign governments.

The Switlik standard models include seat-and-back-pack types, in both ordinary and quick-attachable varieties. In using the quick-attachable design, the pack remains in the ship and the flyer wears only the harness, which may be attached to the pack in a single operation.

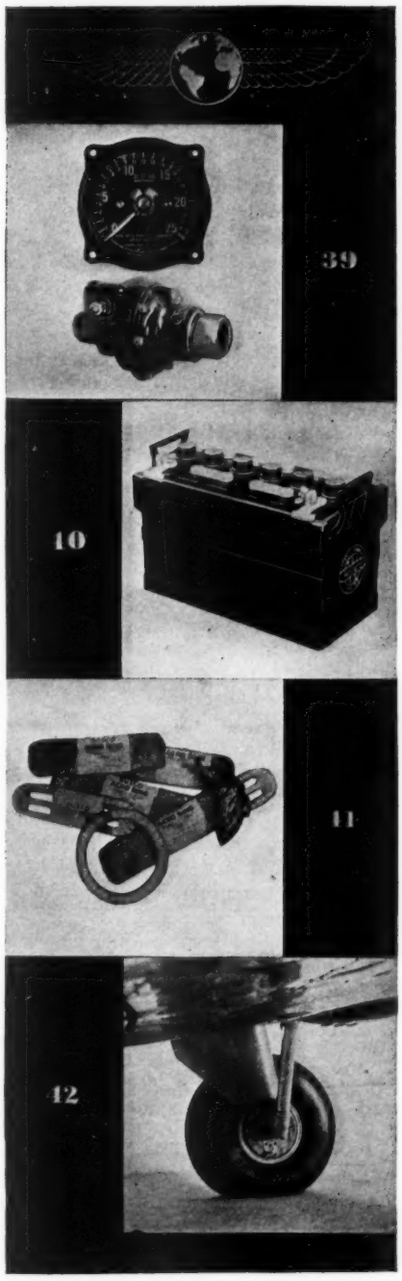
Latest Switlik design is the chair-chute for cabin airplanes, essentially a quick-attachable back pack upholstered to match the cabin interior and designed with special fittings for attachment to the frame of the chair. When the passenger rises with the chute attached the entire back of the chair is removed, a feature which assists in making a hurried exist. (Number 37)

Pyle-National Company, Chicago, Ill.

AT THE PRESENT TIME there is scarcely a country with any large volume of aeronautical activity that has not purchased Pyle-National aeronautical equipment. Aircraft lighting equipment includes landing lights with reflector sizes of 6, 9, and 12 in.; navigation lights, in sets of three, to fit either thick or thin wings or rudders and give light on both sizes; and toggle switches rated for conventional storage-battery voltages and for lines carrying from 10 to 35 amperes.

Included in the airport and airway equipment are field floodlights with 23-in. or 36-in. reflectors; ceiling height projectors and indicators; rotating beacons; flashing code beacons; standard Department of Commerce 18-in. course lights; semi-submerged runway marker lights; wind tees; obstruction and approach lights; cast bronze or aluminum boundary lights; and cone type field boundary light fixtures designed to outline the field sharply both by day and by night.

For airports remote from the power lines, a series of gasoline electric plants having outputs ranging from 1½ to 3 kva. (115 volts, 60 cycle A.C.) can be furnished. They can be fitted either for hand or full automatic starting. (Number 38)



Weston Electric Instrument Corporation, Newark, N. J.

MANY INDUSTRIES have been served by Weston equipment since 1888, and a special department is now devoted to the development of aeronautical appliances. As a result of close cooperation with many users a line of aircraft instruments has been produced which includes electric tachometers, engine cylinder temperature indicators, oil temperature indicators, air temperature indicators, carburetor intake thermometers, battery circuit ammeters, compass indicators, and blind-landing indicators. The last named instrument has been developed for use with the new Department of Commerce blind-landing apparatus described in AVIATION for May, 1933. All Weston instruments are provided with magnetic shielding, and can be fitted with static shielding to prevent difficulties with radio reception. Mounted in standard cases, they are designed especially to withstand severe vibration conditions. Dials and pointers are coated with luminous paint. For ground work there have been developed testing instruments for airport circuits and also a special beacon control for boundary lights and isolated beacons, built around the Weston photronic cell and turning the beacons on or off, depending on the level of outside illumination.

Weston equipment is used extensively by the military and commercial services of the United States. It has been sold to a number of foreign governments and commercial organizations (Number 39).

Willard Storage Battery Company, Cleveland, Ohio

THE Willard Storage Battery Company had its beginning in 1885 and the present company was formed in 1902. The company has had sixteen years of experience as exporters of storage batteries and have at present established distributors in most countries of the world.

The Types KWR and KRR Willard batteries (9, 13 or 19 plate, 12 volt) were designed paritcularly to meet the requirements of aeronautical service to provide current supply for radio transmitters and receivers, navigation instruments, inertia starters, direct-connected starters, and all lighting requirements. The KRR batteries have threaded rubber insulation, and the KWR employ wooden separators. Hard-rubber non-spill containers and terminals of the standard wing-nut type are used. A special single-cell two-volt battery is also built in this type. This series has been used extensively by the U. S. Navy.

Types AW and AR batteries (13 or 25 plate) are built of designs adopted by the Army and are furnished in both six- and twelve-volt assemblies and in two different capacities of each voltage. TPW and TPR (13-plate, 12-volt) are made especially for commercial service. Reduction in size is possible through the use of a new non-spill feature in which a pendulum vent plug is used. For installations where battery drain is light the SYR (7-plate; 2, 4, 6, 8 and 12 volt) series is recommended. Rubber containers and insulation, non-spill design, and wing-nut terminals characterize this series. (Number 40)

The Russell Manufacturing Company, Middletown, Conn.

IN 1834, Samuel Russell founded his company for the manufacture of narrow fabric webbings. The firm later expanded into the production of elastic webbing, and with the advent of the automobile became one of the first to produce asbestos brake lining.

Aside from the manufacture of brake lining for airplane wheel brakes, Russell manufactures rubber shock-absorber cord both in ring and cord form, aircraft tapes and fabrics, parachute shroud lines, luggage straps, shock-absorber struts, glider and soaring plane catapults, and safety belts. A wide variety of belts are available, for both open-cockpit and cabin airplanes, in plain or fancy webbing and of various colors. (Number 41)

Warner Aircraft Corporation, (Aircraft Products Corporation) Detroit, Mich.

IN OCTOBER 1926, under the name of Aeronautical Industries, Inc., design was started on the Warner Scarab engine under the supervision of W. O. Warner. In 1928 the company's name had been changed to The Warner Aircraft Corporation. Engines were being produced at a leased factory in Detroit, but as the factory's facilities were being exceeded by the increasing demand for engines a modern factory and office building was located at the company's present address at the beginning of 1929.

On January, 1932, after five years devoted exclusively to developing and producing aircraft engines, the Warner Company acquired the assets of the Aircraft Products Corp. and is now building the wheels, brakes, shock struts and other products formerly made by that firm. During the past year development work has been concentrated on the large 15.00-16 wheel for low-pressure tires, fitted with a hydraulically operated brake. It is standard equipment of the new Boeing transport, and is also being used by a number of transport operators on other types of plane where high-pressure tires are being replaced by the low-pressure type. The company's products have been used by American Airways, Bellanca, Boeing, Curtiss, Douglas, Fairchild, Goodyear-Zeppelin, Granville, Martin, Monocoupe, Pan American Airways, Pitcairn, Stearman, United Air Lines, and Waco. (Number 42)

Homestead Valve Mfg. Company, Coraopolis, Pa.

AT IMPORTANT terminal airports in this country time and effort have been economized in cleaning airplanes and engines (also hangar walls, floors, windows, etc.) with the "Hypressure Jenny" manufactured by the Homestead Valve Company.

This equipment is a complete self-contained, high-pressure water heater so arranged that various cleaning compounds soluble in water and not injurious to the machine may be introduced. Each machine consists of a gravity kerosene pilot burner; a pressure feed kerosene main burner; automatic solution and fuel pumps; a heating coil or generator; and an outlet for transmitting the vapor spray. A small electric motor operates the water and fuel pumps through a double reduction gearing.

Aluminum Company of America, Pittsburgh, Pa.

THE Pittsburgh Reduction Company was reincorporated as Aluminum Company of America in 1907. Present headquarters are in Pittsburgh, but the company operates its own bauxite mines in Arkansas and large plants in thirteen different cities in the United States. In 1928 the foreign interests of Aluminum Company of America were reorganized under a new corporation, Aluminum, Ltd., with headquarters at Montreal, and with plants and a world-wide distribution system.

Heat-treated alloys of the duralumin type show tensile strengths in the neighborhood of mild steels and weigh approximately one-third as much. The Aluminum Company supplies few products in fabricated form for direct use by the aircraft industry (notable exceptions: passenger chairs for transports). Its list of materials, however, is long and varied: sheets in many alloys (from the pure metal for such things as lightly stressed fairing pieces to the heat-treated strong alloys and the composite Alclad strong alloy for structural parts, wing coverings, etc.); tubing—round and streamline in various alloys and various conditions of heat-treatment (for fuel lines, struts, braces, etc.); extruded sections to suit customers' requirements (for structural uses, such as stringers. capstrips, wing beams, moldings, etc.); forgings (for fittings, propeller blades, pistons, etc.); castings—sand, die, permanent-mold (for crankcases, cylinder jackets, cylinder heads, pistons. small parts and fittings, etc.); and miscellaneous fabricated parts.

Particular research attention has been paid to corrosion resistance, a problem which inspired the development some years ago of new protective coatings and of the composite Alclad sheet, consisting of a strong alloy core protected by a thin skin of pure metallic aluminum.

Ingersoll-Rand Company, New York, N. Y.

A BACKGROUND of over 60 years in supplying industrial requirements for air compressors and air-driven tools has made Ingersoll-Rand a leader in the field. The company maintains factories in four cities of the United States, and has world-wide distribution facilities. It has available a number of small air compressors and pneumatic tools largely used on airports and in airplane manufacturing and repair shops.

Heald Machine Company, Worcester, Mass.

DURING a continuous existence of over 100 years, Heald company has progressed from a small frame foundry to its large and modern factory at Worcester—its entire history under the management of direct descendants of Stephen Heald, the founder.

Heald grinders are to be found in the shops of leading engine manufacturers, and overhaul shops of most of the domestic airlines. The Models 72A and 55 are particulary adapted for such service. In addition, a smaller type of surface grinder (usually fitted with a magnetic chuck) is made for fitting piston rings. More recently, a line of precision boring tools has been put on the market. The company's foreign business is handled by agents in some eighteen cities distributed over the world.

The Fafnir Bearing Company, New Britain, Conn.

IN 1929 the Fafnir Company made a study of the requirements and produced a line of special aircraft bearings. The users now include companies in Germany and England, as well as the Norwegian Naval Aircraft Factory and the Japanese Air Force and a large proportion of all American builders.

Fafnir Bearings for aircraft are characterized by double seals that allow the bearings to be filled by the manufacturer with an initial supply of lubricant sufficient for the life of the bearing. The dimensions are given in inches (to conform with American practice), and in certain types the bearing bores are made to accommodate standard aircraft bolt sizes. Inner rings extend longitudinally beyond the outer rings to eliminate the need for spacers. High corrosion resistance is obtained by the use of cadmium plate, or in special cases by stainless steel. Bearings are also made without the seal, and special bearings having very narrow widths and the smallest possible difference between the inside and outside diameters are made up for torque-tube service. Self-aligning bearings are also available. Beside the bearings intended principally for control systems, the Fafnir Bearing Company also manufactures a complete line of bearings for engine use. All sizes and types are standardized and are carried in stock for quick shipment.

John A. Roebling's Sons Company, Trenton, N. J.

PIONEERS in the wire drawing industry, it was only natural that Roebling should be identified with aviation at its inception with the manufacture of special wires for aircraft use. From the early days of the Wrights and Curtiss, through the War to the flight of the N.C.4, the famous Lindbergh and Chamberlain flights, up to the recent odyssey of Wiley Post, Roebling products have played their part in epoch making flights.

They manufacture tinned and galvanized wire, strand and cords for interplane trusses and controls; ferrules and thimbles for terminal connections; insulated wire for ignition and radio as well as for airport and beacon lighting. Such products are furnished to practically every well known concern building aircraft in the U.S.A. and to all branches of the Army and Navy.

For lighter-than-air craft special products have been developed such as high strength balloon cable with a telephone conductor center.

Govro-Nelson Company, Detroit, Mich.

ORGANIZED IN 1923, to meet the demand for high-precision machine products for the automative and aircraft industries, the company is now engaged in the manufacturing to engine-builders' specifications, of aircraft engine parts in immense variety. Parts are only made on specific order.

Haskelite Manufacturing Corporation, Chicago, Ill.

INCORPORATED IN 1917, the company maintains its own engineering and research departments and factory at Grand Rapids, Mich. Haskelite has been used on almost all record-making planes, including those of Lindbergh and Post.

Usually made up with mahogany, birch, spruce, or poplar faces with a poplar core, Haskelite is glued with a resin adhesive which is a recent development in the manufacture of plywood. Haskelite is furnished in any thickness from $\frac{1}{16}$ in. upward, in widths up to 92 in., and lengths as desired. By scarfing, larger panels may be furnished. Diagonal-grain wing-beam panels have come into rather common use as the webs of box beams. The panels are

made with the face plies 90 deg. to each other and 45 deg. to the length of the strip.

For cabin heat and sound insulation special panels are made up with a balsa wood core and in a variety of hardwood faces, and a fire-resistant panel has been developed recently.

Another development of the company is Plymetl, a composite material with a core of a stiff plywood panel and sheets of aluminum, duralumin, or any other metal cemented to its surface.

Socony-Vacuum Corporation,
New York, N. Y.

THROUGH ITS various affiliates and subsidiaries which operate in every country excepting Russian, international is the extent of its services to aviation. Socony-Vacuum aviation gasoline is known in the United States as Mobilgas Aviation, but in other countries it is sold under names having local significance. Mobiloil Aero Oil, however, is an internationally known and standardized product with many famous flights to its credit. It was used on the original Lindbergh flight, the Byrd North Pole Expedition, and by Wiley Post and many other noted pilots.

Recently the organization has developed Socony-Vacuum aircraft instrument oil for automatic pilots and other instruments where highly refined lubrication is essential, which operates down to 50 deg. below zero.

A characteristic of Socony-Vacuum Mobilgas Aero, called by its producers "climatic control," is designed to afford high performance regardless of weather conditions. Mobiloil Aero Oil has the same double range characteristics that apply to Mobiloil, giving instant lubrication at starting temperatures and complete protection under extreme heat.

Industrial Engineering Company,
Bridgeport, Conn.

RECENTLY INVENTED and put upon the market is a device to permit the use of machine screws or bolts in locations where ordinary nuts cannot be reached and held. The nut is held in a spring clip which snaps over the edge of the member behind which the nut is to lie, and the torque developed on the nut in screwing a machine-screw home is taken up by the spring clip bearing against the edge of the structural member. Snap-nuts are made for use with round, flat, or mushroom head screws in steel and duralumin, and are most used for attachment of skin, upholstery, trim, fairing, etc.

The company also makes landing-gear-shock struts and miscellaneous mechanisms and are developing a new type of mechanical or hydraulic brakes for small aircraft, especially adapted to amphibions.

Fleetwings, Inc.,
Roosevelt Field, L. I., N. Y.

EARLY IN 1929 a systematic research program involving electric resistance welding of steel for aircraft construction was started. The design and construction of automatic tools for satisfactory shot-welding of stainless steel were finally completed. The Fleetwing process differs from the usual commercial spot-welding processes in its automatic and accurately controlled character. The company has recently concluded a cross-licensing agreement with the Budd Manufacturing Company (page 285), pioneer in a closely related field.

During the past three years the Fleetwings organization has supplied builders with a number of aircraft structural units, including the wing ribs, tail surfaces and ailerons for the "Privateer" amphibian of Amphibions, Inc.

Westport Manufacturing Company,
Glendale, Cal.

TO THE PRIVATE airplane owner and the independent operator Westport offers a complete line of aircraft and airport radio receivers, aircraft intercommunication sets and engine shielding harness.

The receivers are manufactured in two models, one (AR62D) for direct and the other (AR62T) for remote control. Both sets have three stages of tuned radio frequency, a power detector, and two stages of audio amplification. Range is from 235 to 700 kilocycles.

The sets averagaing 15 lb. weight operate either from six or twelve-volt batteries for the filament, and from B batteries of dynamotors for the plate voltage. Overall dimensions, without mounting brackets, $5\frac{3}{4}$x$6\frac{3}{4}$x10 in. A ground station receiver has been developed (Model GR8) which covers all aviation channels—an 8-tube superheterodyne receiver (110 volts). For use in conjunction with aircraft receivers, intercommunication sets are offered.

Westport's radio shielding harness, is adaptable for use either with shielded spark plugs or with separate spark-plug shields. All types are complete with ferrules, rubber glands and nuts, and magneto shield.

Rubbercraft Corporation,
New Haven, Conn.

FLOTATION BAGS, life-rafts, and many other forms of inflatable rubberized fabric products are manufactured by Rubbercraft, subsidiary of Air Equipment Corp. Rubbercraft manufactures all of the fabric items for such equipment, while the Sun Typewriter Company (another subsidiary) supplies the necessary mechanical units, such as oxygen cylinders, flotation-bag containers, inflation systems, and CO_2 fire extinguishers.

Since January of this year contracts have been received from the U. S. Army and Navy for wading suits, life-rafts, flotation bags, emergency hand pumps, life-saving vests, oxygen cylinders and valves, flotation bag inflation gear and two complete non-rigid airship envelopes.

Wellington Sears Company,
New York, N. Y.

AIRPLANE and balloon fabrics have been supplied to U. S. Army and Navy specifications since the outbreak of the war. Considerable research has been done in developing strengths with specific weights to meet the specifications for Grade A airplane cloth established by the U. S. Bureau of Standards. Recently a product has been developed to compete with the foreign balloon fabric which was used as a gas cell fabric on the Macon, a material specified to break both ways at 40 lb. to the inch and to weigh 2.05 oz. or less per sq.yd. For non-rigid ships and for observation balloons a special basket weave has been produced which exceeds the strength of the usual two-ply fabrics by some 20 lb. per in. and at the same time weighs $\frac{1}{2}$ oz. less.

Sealed Power Corporation,
Muskegon, Mich.

FOR MORE THAN a fifth of a century the Sealed Power Corporation of Muskegon, Mich., has been supplying the demands of many leading builders of engines of all classes with its needs in the way of pistons, piston pins and piston rings.

Seamlex Corporation,
Long Island City, N. Y.

ENTERING the field in 1928 with a new method of making seamless flexible metal hose, Seamlex has recently applied the process to aluminum tubing to produce a product suitable for fuel, oil, and hydraulic lines on aircraft at an appreciable saving in weight.

The product differs from standard seamless-flexible tubing in that the corrugations are formed in a continuous left-hand spiral to avoid undue strain in the tubing when tightening the fittings. Moreover, the tubing is drawn down to plain, uncorrugated ends to allow flaring for the application of solderless tube fittings. Two general styles are available—close pitch for high pressures, frequent bends, swivel joints, etc., and open pitch for vibration damping, occasional bending, etc. Due to its seamless construction, the hose may be used for vacuum as well as pressure services. Available sizes range from 1/16 in. to 2 in. inside diameter.

Union Carbide and Carbon Corporation, New York, N. Y.

EVER SINCE welded steel structures have been used in airplane manufacture the various units of Union Carbide and Carbon Corporation have been active in their service to the aviation field. Oxy-acetylene welding equipment for both production and repair are the principal products offered through The Linde Air Products Company, which also handles the distribution of products made by Oxweld Acetylene Company, The Prest-O-Lite Company, Inc., and Union Carbide Company. The latter company also furnishes equipment for acetylene lighting at isolated fields.

Included in the products for aeronautic use are acetylene generators, oxygen manifolds, pressure regulators, complete welding outfits for the factory, and portable welding outfits for repair work, as well as the necessary oxygen and dissolved acetylene or calcium carbide. The Oxweld Type W-15 aircraft welding blowpipe is specially designed for airplane manufacture.

American La France and Foamite Industries, New York, N. Y.

THIS EQUIPMENT may be found in both airplanes and hangars operated in the United States and throughout South American countries.

Products range from the one-quart carbon tetrachloride hand-gun type, developed especially for electrical equipment where live voltages may be encountered, up to completely motorized fire-fighting chemical trucks. Foamite extinguishers of various sizes are available ranging from the 2½-gal. hand type up to 40-gal. two-wheeled hand trucks, also 40-gal. tank units designed to be installed on crash trucks for airports. In addition. a continuous Foamite foam generator has been designed for use with pressure water systems. Foamite apparatus generates a volume of foam from six to ten times its liquid capacity. Another type of extinguisher, the Alfite, uses compressed carbon dioxide gas as a fire-smothering medium. The expansion is ninefold when released. Soda-acid extinguishers, as well as types created especially for outdoor service under freezing conditions, are also available.

Timken Roller Bearing Company, Canton, Ohio

TAPERED ROLLER BEARINGS by the Timken company have found a growing place on modern aircraft as the weight of transport planes has increased and as the operator's demands for long life and trouble-free operation have become progressively more stringent.

Chief employment of bearings of the Timken type has been in the landing gear, particularly in wheel hubs. Timken has produced a series of bearings especially suitable for this job in a wide range of load carrying capacities. A much more recent application is in engine rocker arms. Rocker-arm bearings have been one of the most vulnerable parts about an aircraft engine. They require constant lubrication to maintain the close clearances required for satisfactory valve operation. Small bearings have been designed by Timken engineers to replace the older plain bushings and thus to eliminate many of the troubles from this source. Timken rocker-arm bearings have recently been made standard equipment for all aircraft engines of one of the leading engine manufacturers.

Thiokol Corporation, Yardville, N. J.

ETHYLENE TETRASULPHIDE (produced by interaction of ethylene dichloride and a soluable polysulphide) is known commercially as Thiokol, and is finding an increasing number of industrial uses. Since the material is impervious to and insoluble in gasoline and oils it is being applied as a lining for fueling hose at airports. It remains flexible under a wide range of temperature conditions, and its resistance to decomposition eliminates the possibility of foreign matter getting into the gasoline. It has been tested extensively by the Department of Commerce as a lining for crash-resistent fuel tanks. The Thiokol Corporation does not supply any form of finished article, but furnishes the basic materials for fabrication.

TiteFlex Metal Hose Company, Newark, N. J.

ON AIRCRAFT power-plant installations vibration introduces a problem in keeping fuel, oil, and cooling-liquid lines tight. For some 16 years the TiteFlex Company's flexible tubing has been successfully coping with that problem. TiteFlex metal hose is now approved by the United States Navy for airplanes manufactured under naval specifications, and it has been used for many years by foreign governments. A factory is maintained in Berlin. It has been approved for fuel lines by the U. S. Dept. of Commerce.

An all-metal flexible hose for carrying liquids and gases under pressure, TiteFlex consists essentially of a corrugated tube made up of a preformed strip, spirally wound into a convoluted tube having a double-locked seam on top of each convolution. Tubing can be made up of various metals, brass being the common standard. A complete line of fittings is manufactured for TiteFlex tubing, and all couplings, unions, elbows, and so forth, conform with S.A.E. specifications for automotive and airplane plumbing.

Caterpillar Tractor Company, Peoria, Ill.

THE Caterpillar Tractor Company was organized in 1925, and pioneered in the manufacture of diesel tractors, announcing their first diesel model in August, 1931. These machines have been used extensively in airport construction. At present there are three diesel tractors in the Caterpillar line ranging to 38 to 80 drawbar horsepower. Of the four-cycle valve in head type engine with individual fuel pumps for each cylinder, the number of cylinders range from 3, 4 and 6. The bore is 5¼ in., the stroke 8 in., and most of the parts are interchangeable. The starting engine is an auxiliary two-cylinder, four-cycle, gasoline type. Caterpillar diesel tractors are now in use in 44 states of the United States and in fifteen foreign countries and possessions. The company also builds six models of gasoline tractors.

Claude Neon Lights, Inc., New York, N. Y.

ALMOST EVERY PILOT has observed the powers of penetration of the neon tube. The exclusive owners of U. S. A. patents on Claude tubes is Claude Neon Lights, Inc., New York City, and its licensees in all parts of the country.

For aeronautical purposes this company manufactures the Claude Neon roof signs for airport marking; Neon illuminated wind tees; Neon boundary markers, building markers and meridian markers; and high-intensity beacons.

Parker-Kaylon Corporation, New York, N. Y.

VERY OFTEN in aircraft construction it is desirable to fasten materials where only one side of the assembly is accessible. Especially adaptable to such problems are Parker-Kalon Type "Z" self-tapping sheet metal screws.

The self-tapping sheet metal screws are used for attachment of cowlings, fairings, skin coverings, interior and exterior trim upholstery, interior and exterior panels. Although the screws resemble conventional machine screws in appearance, they tap their own threads as they are turned into a drilled, punched, pierced or molded hole. The Type "Z" screw is supplied in a complete range of stock sizes for making fastenings to sheets and plates from .015 in. to .203 in.

Parker-Kalon also makes Type "U" hardened metallic drive screws primarily intended for permanent fastenings.

Other products include hex head hardened self-tapping cap screws, cold-forged wing nuts, etc.

The Texas Company,
New York, N. Y.

TEXACO appeared in 1902 from Spindletop Hill in Texas, the site of one of the world's greatest gushers, and today distributes in every state of the Union and in all principal foreign countries. The company was among the first to recognize aviation as a field for extension of sales operations, and in 1927 launched its aviation division, which is now under J. D. (Duke) Jernigin.

Since 1928 Texaco has owned and operated a number of high-speed airplanes (Lockheed, Mystery S, "Sky Chief") which, in the hands of Frank Hawks and other well known pilots, have established records on the airways of this country and Europe. Its present fleet of ships is in all parts of the country for service testing Texaco products.

Texaco's servicing facilities are world-wide as indicated by the distribution of its products for the Ellsworth Transantarctic Expedition to such far-removed points as Aeslesund and Bergen, Norway; Cape Town, Africa; the Panama Canal Zone, and Dunedin, New Zealand.

Dry-Zero Corporation,
Chicago, Ill.

THE NOISE ABSORBING QUALITY of Dry-Zero, brought out in recent tests of the sound laboratories of the U.S. Bureau of Standards, has been responsible for its use by a great number of aircraft manufacturers, including Ford, Curtiss, and Pitcairn Aircraft on their cabin autogiro. Normally the material is supplied in a blanket, which consists of a batt of ceiba fiber in light muslin stitched about every nine inches. The fibers are in a semi-felted condition, and are "grained" (*i. e.,* laid substantially parallel and across the line of sound transmission or heat flow). Through a recent development it is possible to have smooth, hard interior cabin walls of sheet metal or synthetic resins without indentations or perforations, and yet keep reverberation to a minimum.

Wyman-Gordon Company,
Worcester, Mass.

FOR 50 years Wyman-Gordon has been supplying forgings for the transportation industry. Organized originally for producing bicycle and railroad forgings, the advent of the automobile in the early 1900's opened up a new field. The company conducted extensive research in the heat-treatment of steel and was early in a position to furnish heat-treated forgings. The post-war developments in aircraft opened up the way for specialization in aircraft forgings. The aircraft experience dates back to the war. At the present time a number of aircraft engine manufacturers use Wyman-Gordon forgings extensively, for crankshafts and miscellaneous parts, such as connecting rods, cams, gears and hubs.

A recent development has been in the production of aluminum alloy forgings, among them a forged aluminum-alloy piston which is now one of the principal aircraft products.

Berry Bros., Inc.,
Detroit, Mich.

ALL TYPES of Berry finishes for aircraft,—dopes, lacquers, etc. are made available in most countries of the world through the foreign representatives of Berry Brothers. Berry finishes are used not only on a large number of domestic lines but on certain foreign lines in Europe, South America, China, Australia and other points in the Far East.

They are adaptable to the coating of all types of material used in aircraft, fabrics, steel, aluminum and its alloys, plywood, and so on indefinitely. They are available in some thirty standard colors, and special colors may be made up when 50 gal. or more are required. Clear, semi-pigmented, and pigmented dope finishes are available, and are so compounded that they will receive a very high polish. Pyroxylin and oil base finishes are also furnished for metals and wood. A full line of cleaning and rust-proofing materials is carried, and heat-resisting enamels are furnished for use on engines.

In the laboratory and in the course of field experience, the company has worked out the complete technique for the application under all conditions. A booklet, "Specifications for Aircraft Finishing" furnishes all the necessary information as to finishing schemes.

The Dow Chemical Company,
Midland, Mich.

ALLOYS of magnesium containing relatively small percentages of aluminum have been found to serve a number of industrial uses. Because of unusually low specific weight (approximately 0.064 lb. per cu.in.) the stronger magnesium alloys have had special attraction for aeronautical designers. Magnesium base Dowmetal alloys have been used in this country and abroad for many aircraft parts. These alloys are two-thirds as heavy as aluminum alloys, less than one-fourth as heavy as steel, and one-fifth as heavy as brass.

Five standard alloys are now available: Dowmetal A (for high-strength, high-ductility, heat-treated castings or mechanically worked parts requiring maximum strength); Dowmetal E (for castings requiring good strength without heat treatment and for mechanically worked parts requiring strength with high ductility); Dowmetal G (for heat-treated castings where high yield point and hardness are of prime importance; Dowmetal F (for forging, rolling and extrusion where maximum ductility is required); and Dowmetal M (for maximum corrosion resistance—primarily for cast and fabricated parts not subject to maximum stresses). Cast Dowmetal ranges in tensile strength from 28,000 to 31,000 lb. per sq.in. without heat treatment, and from 31,000 to 38,000 lb. per sq.in. heat treated. Dowmetal extruded shapes run from 38,000 to 42,000 lb. per sq.in., forgings from 34,000 to 39,000 lb. per sq.in. Sheets show a tensile strength of from 32,000 to 37,000 lb. per sq.in. Dowmetal may be machined or worked with ordinary machine tools, and readily welded either by gas or electricity. Special surface coatings have been developed for corrosion protection.

Yoho & Hooker,
Youngstown, Ohio

SITKA SPRUCE, plywood, balsa wood, basswood, chestnut, mahogany, Spanish cedar, maple, hickory, ash, walnut, poplar, oak fir, birch, prima vera, and barriguda, make up the formidable list of woods which Yoho & Hooker offer aircraft manufacturers for various uses. Aircraft glue is another product supplied by this company to the industry. All material is selected to comply with the specifications set forth by the U.S. Army and Navy for these products.

Bakelite Corporation,
Bound Brook, N. J.

BAKELITE, a purely synthetic product, has found an infinite number of applications, and in many places has superseded products made of metal or wood.

Bakelite materials are produced in rods and tubes, baking varnishes, enamels, lacquers, and cements, transparent materials and oil soluble resins for the production of quick-drying finishes, moulding material, and laminated sheets, the last two most widely used in the aircraft field. Molded products are used in magneto housings, distributor covers, and switch bases. The laminated material, made from sheets of fibre or fabric, impregnated with Bakelite varnish, is used for electrical insulation. It is also used for gears, and pulleys, as well as panelling and interior trim in cabins and cockpits, and because of its lightness, strength, and toughness it is often used in place of metal parts. The transparent materials are used for handles and gasoline gauges. In electrical units, such as motors and generators for radio and lighting, the baking varnishes are used for the impregnation of coils and windings. The cement is employed in sealing electric light bulbs to their bases. Durable finishes are made from the oil soluble resins.

Shell Oil Company,
New York, N. Y.

FROM A MODEST BEGINNING in California some 20 years ago Shell interests in the United States have expanded to cover all phases of the production and distribution of petroleum products for automotive, aircraft and other industries. At present the Shell Oil Company covers the Far West, the Shell Petroleum Corporation the Mississippi Valley, and Shell Eastern Petroleum Products, Inc., the Eastern seaboard and the New England States. Shell produces aviation gasolines, aircraft lubricating oils, and special rocker-arm lubricants to meet the particular requirements of the industry.

Each of the three Shell subsidiaries in the United tates maintains its own aviation department. Each division maintains flying equipment for experimental purposes to a total number of ten planes.

Shell products have taken conspicuous part in many famous flights, both in this country and abroad. The Martin Johnsons took Shell products to Africa; Von Gronau and Captain Mollison made east-to-west Atlantic crossings during 1932 with Shell; American Airways and other transport lines use Shell fuel; and a number of European transport lines standardize on it.

The Imperial Brass Mfg. Company,
Chicago, Ill.

SINCE 1905, Imperial has supplied brass products for automotive and industrial fields and more recently for aircraft. All foundry work, machining, and finishing are done in their own plant. In their aircraft line is included toilets, wash basins, drinking fountains. Some have been supplied to the Avia Company of Czechoslovakia, as well as to the Goodyear-Zeppelin Company for the U.S.S. Akron and the U.S.S. Macon and to a number of American aircraft manufacturers. The company also makes a primer pump which is used by the government, as are many of their standard plumbing fixtures, pipe fittings, heavy duty tube couplings, shut-off cocks, and tube-bending and tube-cutting tools.

Walter Kidde & Company,
New York, N. Y.

A SPECIAL airplane fire extinguisher has been designed to operate around the engine, either on the ground or in flight. Instead of using a liquid extinguishing agent, the Lux extinguisher envelopes the flames directly with a cloud of inert carbon-dioxide gas.

The extinguisher consists of a special light cylinder containing the gas and usually installed against the fire bulkhead, a ring of perforated piping installed around the engine mounting to distribute the gas, and a control handle on the instrument panel to release the gas. Complete equipment for a single-motored machine weighs 19 lb., for a twin-motored plane 26 lb., and for a tri-motor 29 lb. Lux portable extinguishers are also available in a range of hand types and truck units for hangar and airport use.

Stewart Hartshorn Company,
New York, N. Y.

DURING the World War the Stewart Hartshorn Company developed, with the assistance of the United States Government, streamline wire tie rods for use in bracing the external parts of airplanes. The streamline effect of this tie rod offered very much less surface to the wind, enabling the plane to gain a much higher speed, which in turn meant considerable economy in fuel.

Hartshorn streamline wires are drawn and cold rolled from the best quality electric furnace carbon rod obtainable and by special heat-treating processes high tensile strength and excellent ductility is obtained. Hartshorn streamline wires are produced by the cold reverse rolling method.

In 1926 the Stewart Hartshorn Company developed a square section internal tie rod which supplanted the old swaged type. This square section internal tie rod is used widely for internal fuselage and wing bracing. The reduced portion of such rods, converted to a square cross section, affords an excellent means of adjustment and, at the same time, affords minimum weight with maximum strength.

Marlin-Rockwell Corporation,
Jamestown, N. Y.

THE BEARINGS manufactured by SRB, Gurney and Strom are now available to the Aeronautical Industry through the sales organization of Marlin-Rockwell Corporation. The factory at Plainville, Connecticut (one of three producing plants) particularly specializes in this field. MRC-SRB bearings have participated in many famous flights, including Lindbergh's to Paris, Byrd's to the two Poles, Boardman and Polando's to Turkey, and Post and Gatty's around the world. They have been used in military aircraft during and since the war, and are at present being widely used by all leading engine manufacturers.

The list of Marlin-Rockwell products includes: Single and Double-Row bearings; Single-Row bearings of narrow width (special aeronautical V series); Single-Row Lubri-Seal bearings (sealed against the escape of the initial supply of bearing lubricant); Single-Row double-shield Lubri-Seal and Double-Row Lubri-Seal bearings; Radial bearings with Bakelite compound separators for superchargers; and the Super-Conrad Radial bearings.

Summerill Tubing Company,
Bridgeport, Pa.

IN 1910 the business, which was founded in 1899, was moved to its present plant. From Feb. 1, 1918, to the end of the war Summerill supplied to the Government 3,700,000 ft. of light-gage tubing, practically all for aircraft.

In 1926 an aircraft manufacturer placed a single order for approximately 200,000 ft. of tubing. From that time until 1929 Summerill supplied more than 75 per cent of the steel tubing consumed by American aircraft manufacturers.

During 1932 many special demands were made, among them a call for tapered tubes and tubes with reinforced ends, and progress has been so rapid that regular production of tapered tubes is likely to be undertaken shortly.

Notable among the famous planes built of this tubing are the Navy's NC-4, first plane to cross the Atlantic, and Colonel Lindbergh's "Spirit of St. Louis." The steel tubing in Goodyear-Zeppelin airships is also by Summerill.

Cyclone Fence Company,
Waukegan, Ill.

FOR SOME 46 years Cyclone fences have been used for the protection of industrial plants and homes and for safeguarding the sightseer. The company has solved the problem of making unusually wide openings in the fences (for the passage of planes of great span) by developing several ingenious designs of sliding or swinging gates, or combinations of both. Cyclone fencing is available in wrought iron, of which there are a variety of designs, or in heavily galvanized copper-steel link. The company supplies not only the wire mesh, but also the supporting posts, top guards, and ground anchors.

Atlas Drop Forge Company,
Lansing, Mich.

SINCE 1906, Atlas has engaged in production of rough forgings. The aeronautical production of the company covers both engine parts and airplant units. In the engine forging division is a department equipped to handle chemical and physical testing, including microscopic and photographic studies, and to check heat treatments. More recently the company has also developed a wide range of forged airplane fittings, such as spar splices, spar terminals, forks for adjustable stabilizers, door latches, and other miscellaneous parts.

Met-L-Wood Corporation,
Chicago, Ill.

A MATERIAL is produced that is used by a number of airplane manufacturers as a lining for cabins. It is made with a single-ply poplar core, with a solid aluminum face on one side and a perfor-

ated aluminum face on the other. By the perforation of one sheet moisture in the panel is allowed to evaporate. This panel weighs 7 to 8 ounces per square foot and is $\frac{1}{10}$" thick.

Thurston Cutting Corporation, New York, N. Y.

MANUFACTURED to the specifications of the U. S. Army and Navy "Dartmouth-Tex," used for more than eighteen years by the aircraft industry. Dartmouth Tex is used as covering on such ships as the Curtiss Hawk, Falcon, and Condor, the Martin Bombers and torpedo planes, and planes manufactured by the Consolidated Aircraft Corporation, Douglas Aircraft Company, and the B/J Corporation. The Byrd Antarctic expedition pressed it into service for windproof garments.

Among the other products of the company are grade A airplane surface tape, pinked edge and sealedge; balloon cloth; balloon cloth surface tape, pinked edge, and sealedge, and specially woven units of strong, light-weight fabrics used for life rafts, etc.

E. I. Du Pont de Nemours & Company, Wilmington, Del.

ACTIVELY INTERESTED in the aviation industry in furnishing materials for fabric and metal finishes for many years, during the war du Pont dopes and finishes were sold extensively to the government services. The company now has available a full line of clear nitrate dopes, fully pigmented nitrate dopes, semi-pigmented nitrate dopes, and acetate dopes. With the advent of the metal airplane, Dulux finishes have been developed especially for the protection and finishing of dural and other light alloys. Prof. Piccard and Comdr. Settle used Dulux on the exterior of the gondolas of their stratospheric balloons. The U.S. Navy and the Vought, Douglas, Boeing, Consolidated and Curtiss-Wright companies are also users. Products are distributed in the United States and abroad.

Seaman Paper Company, Chicago, Ill.

SEAPACK, a Seaman product is derived from Kapok, a silky tropical fiber long recognized as one of the most efficient insulation materials. The 1933 Curtiss-Wright Condor is an example of its use. Loose Kapok is difficult to handle, an objection eliminated by Seapack, which is essentially Kapok fibers processed into sheet form. It may be furnished either plain or reinforced by paper or cardboard backings, and is available in sheets or rolls up to 126 in. wide, with a maximum length of about 150 yards. Plain Seapack comes in two thicknesses (approximately 1/11 and $\frac{1}{8}$ in.) and may readily be fireproofed by spraying with suitable fire-resistant chemicals. Its specific weight is 0.5 oz. to 0.9 oz. per sq.ft.

Paasche Airbrush Company, Chicago, Ill.

FOR MANY YEARS Paasche has made spraying equipment for applying of finishes to fabric and metal. In addition to the manufacture of airbrushes, and air-finishing equipment, Paasche makes all of the necessary auxiliaries, including air compressors, ventilators, rubbing and sanding machines, hose and couplings, gauges, and sprayroom lamps. Their apparatus is used by the Goodyear-Zeppelin Corporation, Boeing and others.

The Vellumoid Company, Worcester, Mass.

FOR MORE than 20 years, Vellumoid has been supplying soft fibre packing and gaskets to the automotive, aircraft, and allied industrial fields. The British Sunbeam, the Spanish Hispano-Suiza, and the United States Liberty engines were Vellumoid equipped. Today many of the transport lines, as well as certain of the military services make extensive use of the material. Many factory-cut gaskets are used in this country, but abroad Vellumoid in rolled sheet form seems to be most popular. In cooperation with leading engine manufacturers in the United States complete gasket assemblies for specific engines, individually packaged, are being marketed.

Hazard Wire Rope Company, New York, N. Y.

STAINLESS STEEL aircraft cable under the trade name "Korodless" is a recent development. The company has been in business since 1846 and has manufactured wire rope for a great many purposes in industry, but Korodless is the first application of 18-8 (18 per cent chromium—8 per cent nickel) alloy stel to wire rope.

Korodless aircraft cables are manufactured in accord with the latest Army and Navy specifications and have been approved by the Naval Bureau of Aeronautics and by the Department of Commerce. They have been used as surface controls, engine controls. anchor ropes, and for various other purposes by the Navy and other government departments, aircraft manufacturers and transport operators. The company also supplies tinned and galvanized cable.

Lubriplate Corporation, New York, N. Y.

A REVOLUTIONARY TYPE of lubricating material, whose outstanding property is its ability to deposit electrolytically a thin film of zinc on bearing surfaces has appeared under the trade name of Lubriplate. It is available in two general forms—fluid Lubriplate (in four different viscosities ranging from 60 Saybolt seconds at 100 deg. F. up to 260 Saybolt seconds at 210 deg. F.) and non-fluid Lubriplate in two grades (depending upon the requirements of use), each grade in three densities—light, medium and heavy. It has been applied to rocker-arms and push-rods, wheel bearings, control bearings, magneto bearings, and controllable-pitch propellers. (Used on Post's world flight.)

The Belden Manufacturing Company, Chicago, Ill.

ALL TYPES of wiring are available, built to Army and Navy specifications, for aircraft ignition, lighting and radio wiring. Cables are made up with single, double and triple conductors, and with various types of insulation (rubber, varnished cambric tape, braided cotton, etc.) both in the plain and shielded styles. Radio-shielded cables are basically similar to the unshielded, except that they have an outside covering of braided tinned copper wire. This company also manufactures braided shielding of tinned copper which can be used in connection with practically any type of wiring or used by itself for bonding the structure. It comes in tubular form, with inside diameters ranging from 25/32 to 13/64 in.

Cuno Engineering Corporation, Meriden, Conn.

HAVING MANUFACTURED electrical automotive equipment since 1919, this company undertook the development of a filter for automotive lubricating and fuel oils in 1927. The Auto-Klean filter which resulted permits the cleaning of the filtering element without interrupting the flow of lubricant. Since 1929 Cuno oil filters have been standard equipment on Curtiss-Wright engines. The engines of the DO-X were Cuno equipped, and the second Byrd Antarctic expedition will have the filters fitted to its Condor. Filters are available for a wide range of conditions in pipe sizes from $\frac{1}{8}$ in. to 8 in.

Air Reduction Sales Company, New York, N. Y.

PRACTICALLY EVERYTHING for the gas welder is included in the Air Reduction catalog, and the company's products have been used for some 25 years in the United States and Europe. With the advent of steel tube construction for aircraft, a considerable field for gas welding equipment was opened up in manufacturing plants and in maintenance shops.

Airco apparatus includes welding torches and tips, regulators. pressure

gages, acetylene generators, welding fluxes, etc. Complete welding outfits consisting of all the necessary torches, tubing, regulators, wrenches, lighters, and even operator's goggles are put up and marketed for general shop use. Outfit No. 91 has been especially developed for aircraft welding.

The Balsa Wood Company, Brooklyn, N. Y.

BALSA, which has a specific gravity of barely 0.1, finds extensive use in fairing-pieces, in insulated paneling (either alone or in composite form with other materials).

It is effective both as an insulant and as an isolator of motor noise and vibration, and for these reasons the material finds considerable favor in construction of cabin ships, particularly of the transport type.

The Balsa Wood Company, among the world's largest producers and distributors, maintains plantations in the Andean foothills of Ecuador and has developed special methods for curing and milling the wood. Its product is Lata Balsa, and is available either in lumber form, or in manufactured panels of all sizes up to 4 in. thick by 40 in. wide and 12 ft. long. In commercial condition, the material ranges from 6 to 9 lb. per cu.ft. in weight. Balsa with a density of 7¼ lb. per cu.ft. shows a yield point of 825 lb. per sq.in. parallel to the grain and 60 lb. per sq.in. perpendicular to the grain; a modulus of rupture in bending of 1950 lb. per sq.in. and a modulus of elasticity of 240,000 lb. per sq.in., (giving it roughly one-fifth the strength of airplane spruce, but only about 20 per cent less strength for the same weight). Its thermal conductivity is rated by the Bureau of Standards as 0.31 b.t.u. per hour per degree F. per sq.ft. per in. of thickness (cf. Sheet Cork 0.32; Yellow Pine 1.00).

Kendall Refining Company, Bradford, Pa.

LAST YEAR Kendall celebrated the 50th anniversary of active refining of Pennsylvania crude oils for industrial and automotive fuels and lubricants. Its refineries at Bradford incorporate the most modern equipment for the production of petroleum products for a wide range of uses. Aviation requirements have come in for a full share of attention in the past few years. Many winners of National and other air races since 1929 have used Kendall oil, as have Jackson and O'Brine (endurance), Gee Bee (speed), and Boardman and Polando (distance).

Distribution is on a nation-wide scale, many airports carrying a full stock. Latest development, following the most modern automotive practice, is the marketing of lubricating oils in sealed-at-the-refinery one- and five-quart cans. Purpose: convenience in carrying, and the prevention of contamination and substitution.

S.K.F. Industries, Inc., New York, N. Y.

MANY of the airplanes and engines taking part in the famous flights of the last decade, as well as a large share of those that do the ordinary day-to-day business of commercial air transport are equipped with S.K.F. anti-friction bearings. Although they are made in a wide variety of types and sizes to meet practically any need of the aircraft industry, the types most commonly used are the cylindrical roller bearings, deep-groove ball bearings, and particularly self-aligning bearings. They are standard equipment on engines, planes, starters, beacons, etc., made by many manufacturers for governmental and commercial purposes. In the background is an experience of over a quarter of a century in the manufacture of precision ball and roller bearings.

MacWhyte Company, Kenosha, Wis.

AS A MANUFACTURER of wire rope and specialties MacWhyte became interested in the manufacture of streamline tierods when they first became popular during the World War, but it was not until 1922 and 1923 that tierods came into extensive use by commercial and military airplane manufacturers. Since then they have been used to replace cable and hard wire in most newly-designed planes.

Streamline and internal tierods are obtainable in two types. Type 1 is made of half-hard carbon steel, while Type 2 is of corrosion-resistant nickel-chrome steel. The Type 1 tierods, including the threaded portion, are cadmium plated. Type 2 is polished with chromium oxide and the surface finished to withstand a 700-hour salt spray test witout showing rust spots. The rods may be had with various combinations of reduced and non-reduced sections, are threaded right-hand and left-hand, and can be made up with any combination of threads. There are many types of terminal arrangements, including the MacWhyte Safe Lock terminal, with a lock nut that may be tightened to the point of destruction without any injury to the tierod.

American Metal Hose Company, Waterbury, Conn.

HOSE is made up in two general styles: (a) seamless, in accordion wrinkled form to give flexibility (in inside diameters ranging from ⅜ in. to 2 in.. and for internal pressures up to 5,000-1,000 lb. per sq.in.); and (b) interlocked (formed of spirally wound strips with interlocking leak-proof joints). Interlocked hose is available in inside diameters ¼ in. to 8 in. Brass, bronze aluminum, monel, stainless steel, etc., may be used with braided wire, spiral wire, or flexible armor for external protection. The company also manufactures terminal fittings, couplings, etc.

Packard Electric Corporation, Warren, Ohio

LITERALLY HUNDREDS of feet of insulated wire go into a transport ship. Packard Electric, founded in 1890 for the manufacture of electrical conductors, early turned its attention to the problem of airplane wiring and today offers a complete line of insulated wires and cables to Army and Navy specifications. Its products include all types of rubber- and braid-insulated cable, both for high and low tension, plain or shielded; braided copper-shielding (which may be used also for bonding metal parts), and several sizes of armored single cable.

Special attention has been paid to the problem of ignition wiring, using shielded cable. The No. 844 cable is designed especially for this service. Packard also offers rubber-covered extension cords for portable lights.

Nicholas-Beazley Airplane Company, Marshall, Mo.

AIRPLANE SUPPLIES, materials, accessories, flying equipment, and clothing are carried for wholesale and retail distribution. Branches at Floyd Bennett Field, N. Y., and at Los Angeles, Cal., carry in stock between $40,000 and $50,000 worth of up-to-date material and $500,000 worth is on hand at Marshall. Among the major items in export shipments have been flying suits, helmets, goggles, winter flying mocassins, fabrics, wing dope aircraft finishes, wing tape, nickel steel bolts, turn-buckles, hardware, engine parts, wood and steel propellers, instruments, wheels, tires, tubes, sheet aluminum, sheet steel, and steel tubing.

L. C. Chase & Company, New York, N. Y.

MANY airplane manufacturers have made regular use of Chase upholstering materials for cabin lining and seating requirements. The company was founded in Boston in 1843. Aircraft curtain and drapery material is supplied from the Goodall Worsted Mills at Sanford, Maine; artificial-leather seat-coverings from the Sanford Mills, at Reading, Mass.; and certain robes and steamer rugs supplied to aircraft manufacturers have been produced at the Troy Blanket Mills in Troy, N. H. Chase fabrics are available in a wide range of finishes and colors.

Edward G. Budd Mfg. Company, Philadelphia, Pa.

THE BUDD system of stainless steel construction, which has been developed around the "shotweld" process of fabricating high tensile "18-8" stainless steel, has been made available to the various vehicular arts where light weight and great strength are required. The process is available to aircraft manufacturers and licenses have been arranged with leading manufacturers in France, Italy, England and Germany. In America Fleetwings, Inc. is operating under this system. This method is also used in the construction of rail cars, truck bodies, and during the last year has found a useful field in naval ship construction.

Stanavo Specifications Board, Inc., New York, N. Y.

ORGANIZED about five years ago by the Standard Oil Companies of California, Indiana, and New Jersey in an effort to provide the aviation industry with petroleum products of high quality and guaranteed uniformity. After a broad program of development and research, fuel and lubricants manufactured to the Board's specifications were placed on the market in 1930.

Through the marketing facilities of its members and affiliates, the products of the Stanavo Board were made available in North and South America, Europe, Asia, Africa and Australia, and the distributors have rendered many services to trans-Atlantic and other long-distance fliers. Recent examples were that rendered to the Italian squadron under the leadership of General Balbo, Post's round the world flights, and Rossi and Codos' long distance flight to Syria. In addition, Stanavo fuels and lubricants are used on many air transport lines throughout the world, by the air forces in the United States and foreign countries. The new worlds speed record was made by Italy on Stanavo products.

The Lunkenheimer Company, Cincinnati, Ohio

IN COOPERATION with the Curtiss Company, Lunkenheimer made their first connection with the development of aircraft fittings in 1915. During 1917 and 1918 Lunkenheimer actively cooperated with Curtiss, Dayton-Wright and McCook Field engineers in the development of oil and fuel system fittings and equipment. Late in 1918, at the request of the Army Air Corps, the designs for standard soldering unions and fittings were developed.

Priming pumps, brass-bodied and arranged for instrument-board mounting are furnished either with or without shut-off cocks. Multi-engined designs have been developed where one priming pump is used in connection with two or more shut-off cocks.

Other accessories for aircraft fuel systems have more recently been developed, among them a gasoline strainer approved by the military services. In cooperation with engineers at Wright Field, a Y oil drain cock has also been designed and adopted as standard.

Evans Appliance Company, Detroit, Mich.

SINCE organizing in 1927 Evans has specialized in the manufacture of gasoline and oil pumps for internal-combustion engines. The chief product is the gasoline oil and water pump.

The Evans pump is of the rotor-vane eccentric type, having two vanes held flush against the bore of the pump by means of a spring which automatically compensates for wear. With a capacity of 220 gallons per hour, aviation pump can be set for any predetermined pressure. It is featured by a flexible shaft, a sylphon seal, an adjustable internal relief valve, and a valve to permit free flow through the pump to the carburetor when the hand wobble pump is being used, so eliminating excess tubing.

Among other aircraft engine manufacturers, Pratt & Whitney, Wright, Continental, Warner, and Menasco have been users of Evans pumps. Direct sales have been made to manufacturers in Sweden, Germany, and Czechoslovakia.

Continental Steel Corporation, Kokomo, Ind.

ONE OF the best-known installations of Continental Chain-Link steel fencing surrounds Wright Field, the Army Air Corps' engineering base. The fencing is made up of zinc-coated steel wires woven with special reference to neat appearance, sturdiness, and ease of installation. The fence around Wright Field has a triple row of barbed wires at the top. There are a variety of standard forms for factory property and airports and other purposes, and including gates and entrances of appropriate design. The entire fence was erected by the Continental Steel Corp.

American Chemical Paint Company, Ambler, Pa.

THE PREVENTION of rust or oxidation of metal by the application of suitable coatings is a special problem. Two products have particular aeronautic application—a cleaner for steel, cadmium, aluminum, and duralumin known as Deoxidine; and Kemick, a black paint for hot surfaces, such as exhaust rings and stacks. For aluminum and aluminum alloys, the dry-cleaning process with Deoxidine is favored. The company has a branch in Windsor, Canada, and its products are being manufactured under license by a number of companies in Europe.

National Tube Company, Pittsburgh, Pa.

LONG A MANUFACTURER of seamless steel tubing, National Tube, subsidiary of the U. S. Steel Corporation, was early in a position to take care of the demand for the new materials and National Shelby tubing has found an important place in aircraft manufacturing during the past decade. All chrome-molybdenum tubes are made from electric furnace steel and are furnished in the normalized condition, which completely relieves residual strains and leaves a surface smooth and free from scale. Materials are made to conform to Army-Navy Specifications for round and streamlined sections, and in the carbon material as well as in the alloy. Streamlined tubes are available in nominal sizes from 1 in. to 5 in., round tubing from ½ in. to 4 in. outside diameter in various wall thicknesses.

The Black & Decker Mfg. Company, Towson, Md.

MANY aeronautical manufacturing and maintenance shops list Black & Decker tools among their equipment. In 1929 the company purchased a Travel Air monoplane for a traveling sales and servicing unit and sent it out on tour about the United States. The company now maintains branches in fourteen cities in this country, and foreign offices in Canada, England and Australia. In addition to the regular B & D tools (electric drills, screw drivers, bench grinders, etc.) several special items have been developed, including aircraft valve-seat reaming and refinishing sets (for specific engines), and the ⅝-in. electric valve refacer, adaptable to all engines.

American Optical Company, Southbridge, Mass.

FOR ALMOST a century, American Optical has specialized in everything that has to do with the protection and preservation of eyesight. Of late years it has turned its attention to aviation, marketing American Transport goggles. They have been tested and adopted by the United States Army Air Corps and by many airlines.

The large, soft rubber cushions on the goggles fit the contours of the face closely. A special ventilation system keeps the lenses clear. Lenses are accurately ground so that no image distortion is produced. All parts can be easily adjusted, removed, or replaced without the use of tools.

Norma-Hoffman Bearings Corporation, Stamford, Conn.

HAVING SUPPLIED all types of ball bearings for industrial uses for some 22 years, Norma-Hoffman very early made a study of the specialized requirements of the aircraft industry and added to its regular line a number of bearings especially suitable for this application.

The Norma-Hoffman products developed particularly for aircraft may be classified as: (1) Extra-light series ball and roller bearings designed to carry heavy loads with a minimum of weight, (for general engine and landing-gear service); (2) completely-enclosed ball bearings, with either steel or felt seals to hold lubricant and exclude dirt, for use in flying control systems and similar applications; (3) high-speed ball and roller bearings to meet the requirements for increasingly high speed supercharger rotors (now operating up to 42,000 r.p.m.); (4) special sensitive small ball bearings for instrument and radio use (for mounting gyroscopic instrument rotors and gimbals, etc.).

Air Associates, Inc., Garden City, L. I., N. Y.

WHOLESALE DISTRIBUTION of all sorts of replacement parts, supplies and materials for airplane manufacture, repair and maintenance, field and shop equipment, and flying accessories is the business of Air Associates at its two plants, in Chicago and on Long Island. Besides handling the standard products of most well-known manufacturers, certain items, such as clothing, goggles, radio shielding and electrical equipment, and hardware specialties are manufactured for its exclusive distribution. A great deal of foreign business has been handled during the past year. During the first half of 1933 alone shipments have been made to airplane and engine manufacturers, air transport lines, military air forces, government agencies, flying schools and supply houses in some 26 foreign countries.

United States Plywood Company, New York, N. Y.

SINCE the World War, U.S. Plywood has been engaged in supplying material to the aircraft industry and the Government. The company introduced a new product, termed "Weldwood," two years ago. Phenolic resin is used as an adhesive, being applied under heat and pressure and giving a product which is quite impervious to moisture. fungus growth, and other forms of bacterial deterioration. Present U.S. Navy specifications for plywood would have been impossible with the adhesives common only a few years ago.

The company is now working on panels combining ferrous and non-ferrous metals in thin sheets cemented to the plywood, and has developed an adhesive for the lamination of the metal to the wood which is sufficiently elastic to compensate for the difference in coefficients of expansion.

Thompson Products, Inc., Cleveland, Ohio

COMING into existence in Cleveland in 1901, the company acquired a Detroit plant in 1916. In 1929 a factory was purchased in Paris, and in 1930 a factory was erected at St. Catherines, Ont., Canada. The company now has five directly owned and operated plants, and twelve branches.

For nearly two decades, the Thompson company has developed and manufactured airplane engine valves of all designs and types, including such materials as tungsten, cobalt-chrome, silchrome, etc., both in solid and hollow stem types. The latter are commonly filled with sodium or other salts to assist in cooling by improved conduction of heat down the stem. Now, Thompson Products, Inc., manufactures approximately 90 per cent of all of the airplane valves used in the United States.

Pennzoil Company, Oil City, Pa.

STARTING its operations in 1886, its first refinery built solely for the manufacture of kerosene, with gasoline, benzine and the residual oils as by-products, it was not until 1916 that the company registered the name "Pennzoil" as a motor oil brand. The Pennzoil company has its own wells in the Pennsylvania fields. Its motor oils are used on a high percentage of the scheduled air transport miles and have been used in many famous flights, including the first three non-stop flights across the continent, the pioneer refueling flight of the Army's Question Mark, and the Wilkins expedition over the North Pole. Pennzoil is available in three aircraft grades known as Aircraft X, Aircraft XX, and Aircraft XXX, having S.A.E. viscosity numbers 60, 70L, and 70H, respectively. A number of greases and other lubricants manufactured by the company are also adaptable to aircraft use.

Metallurgical Laboratories, Inc., Philadelphia, Pa.

FABRICATION and heat treatment of structural units for airplanes have been Metlab's principal activities since the organization of the company. The company has from time to time sold for export parts made from aircraft tubing, heat-treated to high tensile strength and toughness. Included in the special equipment at the plant are tall vertical electric furnaces, designed and constructed by Metlab itself especially for the heat treatment of such fabricated units as wing spars, landing gear axles, and engine mounts of welded chrome molybdenum steel. Practically all work is given a final heat treatment after welding to relieve strains and to develop uniform physical properties in all parts.

Suncook Mills, New York, N. Y.

SELLING DIRECT to the airplane trade, this company maintains a special division for the exclusive production of Flightex fabric and a separate department in the offices for the handling of aeronautical business.

For nearly a decade Flightex Grade A fabric has been sold extensively to the aeronautic industry and many millions of yards have been purchased by the U.S. Army and Navy air services. During the past three years the company has exported fabric and tape to practically all of the countries of South America and made substantial shipments to Canada and China. This material conforms in all particulars to the A-N specifications for Grade A airplane cloth.

Endicott Forging & Mfg. Company, Endicott, N. Y.

EQUIPPED to produce forgings of the drop, upset and hammered varieties this company has long been a supply source for the aeronautical industry. Evenness of quality is evidenced by total rejections, over the past ten years, of less than one-half of one per cent of production.

The Endicott plant is capable of producing forgings varying from a few ounces to 75 lb. in weight. The shop is essentially a jobbing one, and all forgings are made to blueprints and specifications of the customers,

DeVilbiss Company, Toledo, Ohio

FOR ALMOST any type of process requiring the atomization of liquids, DeVilbiss has been supplying equipment for some 25 years. The problem of applying dopes and finishes to aircraft brought the company into contact with the aviation industry about the perid of the war, and since that time it has manufactured spray guns and auxiliary equipment, including air compressors, control valves, and ventilating systems for spray booths. Recently announced is an improved spray gun (Type MB) which differs from preceding models chiefly in that the fluid control valve is operated through a compressed air relay, thus relieving the operator of fatigue.

The Leece-Neville Company, Cleveland, Ohio

SINCE 1921 Leece-Neville engine-driven generators have been used on many different planes fitted with standard generator mountings. Three different 12-volt voltage-regulated generators are manufactured. They have capacity ratings at 2,700 r.p.m. and 15 volts, of 15, 25 and 50 amp. The company has developed three sizes of two-voltage generators, so that a high voltage is available for radio use at the same time that the normal voltage is available. On the low side they all develop 15 volts, with 20, 16 and 16 amp., while on the high side the voltages are 1000, 750 and 500, with mialliamperage at 500, 400 and 200 respectively.

Buhl Stamping Company, Detroit, Mich.

FOR MORE than a half-century engaged in the manufacture of metal products for many industries, at the present time its major aircraft products are exhaust manifolds, and nose cowls, but the line is extended on request to cover any sheet-metal stampings.

No attempt has been made at standardization of these products, as all parts are manufactured to individual specification. Among the airplane and engine manufacturers for whom the company supplies metallic miscellany are a number of the leading units, Wright Aeronautical, Pratt & Whitney, and others.

Parker Appliance Company, Cleveland, Ohio

PARKER has been a maker of pipe connections, cocks, valves, and similar equipment for aircraft plumbing or power-plant installations, in brass and in aluminum alloys. The Parker tube or pipe connection, widely used because of its simplicity and reliability, is based on a flange on each of the tube ends that are to be joined. The flanges are wedged between two parts of the pipe fitting which are screwed together. Connections are made in straight form and in T's, elbows, crosses, flanges, angles, and reducers.

Parker also manufactures tube-bending machines, primers, and a variety of cocks and piping equipment.

American Telephone & Telegraph Company, New York, N. Y.

AS AN ADJUNCT to their radio communication system, many airlines are making use of teletypewriter circuits and equipment produced by A.T.&T. Some 25,000 miles of Bell System wires are in constant use by the airways division of the Department of Commerce to disseminate weather information along the country's airlines. Recently, the teletype equipment has been adapted to transmit weather maps. Eastern Air Transport and Pennsylvania Airlines also make use of teletypewriter service for handling reservations, dispatching planes, and for the transaction of company business.

Gulf Refining Company, Pittsburgh, Pa.

A COMPLETE LINE of petroleum products, from gasoline, lubricating oil, grease, to insecticides and waxes, is marketed by Gulf Refining Company. These products are used extensively in the United States, especially in the automotive field, and are finding a growing place in the aeronautical industry.

In addition to the several grades of gasoline the Gulf Refining Company also produces lubricating oils, greases and penetrating oil to free rusted joints.

Ohio Seamless Tube Company, Shelby, Ohio

SEAMLESS STEEL TUBING was one of the first forms of metal to be applied to the construction of aircraft. Though welded-steel-tube fuselages are less completely ubiquitous than they were five years ago, there is hardly a modern airplane that does not use seamless tubing for either landing-gear or engine mount. It appears to be the most suitable material for these critical parts. One of the leading suppliers is The Ohio Seamless Tube Co., manufacturers of both carbon and alloy tubing to U. S. Government Specifications.

Lord Manufacturing Company, Erie, Pa.

SOME YEARS AGO this company turned its attention to the aircraft field to reduce the effects of engine vibration on airplane instruments. A tangential system of engine supports has been worked out in which torque pulsations are absorbed in shear stress in special rubber bushings. This system is now being employed in Northrop, Stearman, Stinson, Lockheed, Curtiss-Condor and other planes. Shear-stress rubber mountings have been developed for use with instrument panels, radio sets, battery boxes and passenger chairs. Lord Plate mountings come with rubber inserts from 1 to 2 in. in diameter, and with mounting holes ranging up to $\frac{11}{64}$ in.

Bell & Howell Company, Chicago, Ill.

FOR THOSE interested in aerial exploration and aircraft photography, Bell & Howell have designed a new model of their 35 mm. Eyemo moving picture camera.

This model is designed to be motor driven, making remote control practical. Either a 12-volt or 110-volt motor can be used. The motor attachment is easily removed for hand-crank operation. The shutter speed may be varied between 24 and 4 frames per second. The weight of the camera itself is $8\frac{1}{2}$ lbs., and the motor drive weighs $3\frac{7}{8}$.

Raymond Manufacturing Company, Corry, Pa.

ABOUT 1895 Raymond became prominently connected with the development and manufacture of bicycle saddle springs. Next came automobile springs and today the Raymond Company manufactures springs for airplanes. Raymond valve springs were used in the Curtiss engines of the Navy seaplanes that won the speed contests for the Schneider and Pulitzer Trophies in 1923, and again in the St. Louis Robin when it made a refueling duration record of 420 hours in 1929.

Hill Aircraft Streamliners Company, Cincinnati, Ohio

THE QUEST for increased speed through drag reduction created the business of Hill Aircraft Streamliners, whose wheel fairings and cowlings, engine rings, nacelles, wing root fairings, spinners, and tanks are well known in aircraft racing circles. The products are of such a nature that they can be adapted to any type of aircraft, foreign or domestic, in accordance with the requirements of the purchasers, who are transport companies, sportsman pilots, and military organizations.

National Aircraft Materials Corporation, Rutland, Vt.

FROM ITS MILL at East Dorset, Vt., The National Aircraft Materials Corporation furnishes the aircraft industry with parts made from lumber, principally Sitka spruce and ash. Wing spars and struts have been specialties. The lumber is purchased on the Pacific Coast and shipped via the Panama Canal to its destination in Vermont, where it is carefully selected and milled.

S. C. Johnson & Son, Racine, Wis.

HAVE MANUFACTURED floor and auto wax for years, Johnson Wax products are now being used for airplanes; the Auto wax being recommended as a final finish.

At the National Air Races in Los Angeles, Cal., this past July, Ben O. Howard, winner of four of the main racing events, used a finish of this type on his plane. Many other pilots have testified to its value in enhancing the appearance of the ship. prolonging the life of the finish, and making cleaning easy.

INDEX TO DIRECTORY

Airport Equipment Page
American Gas & Accumulator Co..... 268
American La France 280
The Aqua Systems, Inc..... 267
Caterpillar Tractor Company..... 280
Claude Neon Lights, Inc..... 280
Continental Steel Company 285
Crouse-Hinds Company 270
Cyclone Fence Company 282
General Electric Company..... 272
Gilbert & Barker Mfg. Corporation... 272
Pyle-National Company 276
Walter-Kidde Company 282
Westinghouse Electric & Mfg. Company 276

Airplane Parts
American Gas Accumulator Company. 268
Budd Manufacturing Corporation ... 285
Buhl Stamping Company 287
Edo Aircraft Company 267
Fleetwings, Inc. 279
Hazard Wire Rope Company..... 283
Hill Aircraft Streamliners Company... 287
Metallurgical Laboratories, Inc. 286
The Lord Manufacturing Company 287
Parker-Kalon Corporation 280
Raymond Mfg. Company..... 287
Russell Manufacturing Company 277
Warner Engine Company 277

Bearings
Fafnir Bearing Company 278
Marlin-Rockwell Company 282
Norma-Hoffman Bearing Corporation.. 286
S.K.F. Industries 284
Timken Roller Bearing Company..... 280

Fuel and Lubricants
Gulf Refining Company..... 287
Kendall Refining Company..... 284
The Pennzoil Company 286
Shell Oil Company 282
Socony-Vacuum Corporation 279
Stanavo Specifications Board 285
The Texas Company 281

Instruments
Aeromarine Instrument Company..... 268
Consolidated-Ashcroft-Hancock 269
General Electric Company 272
Kollsman Instrument Company 274
The Lewis Engineering Corporation ... 271
Pioneer Instrument Company 273
Sperry Gyroscope Company 276
Westinghouse Electric & Mfg. Company 276
Weston Electrical Instrument Company 277

Materials and Fabricated Parts Page
Aluminum Company of America 278
American Chemical Paint Company .. 285
The Atlas Drop Forge Company..... 282
The Bakelite Corporation 281
Balsa Wood Company 284
Berry Brothers, Inc. 281
L. C. Chase & Company 284
Dow Chemical Company 281
The Dry Zero Corporation 281
E. I. du Pont de Nemours Company .. 283
Endicott Forging & Mfg. Company... 286
Govro-Nelson Company 278
The Stewart Hartshorne Company 282
Haskelite Manufacturing Company.... 278
Industrial Engineering Company 279
S. C. Johnsons & Son 287
The MacWhyte Company 284
Met-L-Wood Corporation 282
National Aircraft Materials 287
National Tube Company 285
Ohio Seamless Tubing Company 287
John A. Roebling's Sons Company..... 278
Seaman Paper Company 283
Summerill Tubing Company 282
The Suncook Mills 286
Thurston Cutting Corporation 283
Thiokol Corporation 280
U. S. Plywood Company 286
The Vellumoid Company 283
Wellington Sears & Company 279
Wyman-Gordon Company 281
Yoho & Hooker 281

Power Plant Parts
American Metal Hose Company 284
The B. G. Corporation 270
Belden Manufacturing Corporation ... 283
The Breeze Corporations, Inc. 275
Champion Spark Plug Company 271
Cuno Engineering Company 283
Eclipse Aviation Corporation..... 269
Evans Appliance Company..... 285
Holley Carburetor Company 274
Hurley-Townsend Corporation 272
Leece-Neville Company 287
The Lunkenheimer Company 285
Packard Electric Corporation 284
Parker Appliance Corporation 287
Sealed Power Corporation..... 279
Seamlex Corporation 279
Scintilla Magneto Company 268
Stromberg Carburetor Company 269
Titeflex Metal Hose Company 280
Thompson Products, Inc. 286

Radio and Communications Page
American Telephone & Telegraph Co.. 287
Western Electric Company 275
Westport Engineering Company 279

Propellers
Hamilton Standard Propeller Company 271
Pittsburgh Screw and Bolt Company.. 273
The Smith Engineering Company 274

Tires
General Tire & Rubber Company..... 270
The B. F. Goodrich Company 275
Goodyear Tire & Rubber Company ... 271

Wheels, Brakes and Landing Gear Struts
Automotive Fan and Bearing Company 269
The Bendix Brakes Company 268
Cleveland Pneumatic Tool Company.. 273
Goodyear Tire & Rubber Company.... 271
Industrial Engineering Company..... 279
Warner Engine Company 277

Tools
Air Reduction Sales Company 283
Black & Decker Mfg. Company 285
The Breeze Corporations, Inc. 275
DeVilbiss Company 286
Engineering & Research Corporation.. 272
Heald Machine Company 278
Homestead Valve Company 278
Ingersoll-Rand Company 278
Paasch Air Brush Company 283
Union Carbide Company 280

Miscellaneous Parts and Accessories
Air Associates 286
Air Reduction Sales Company 283
American Optical Company 285
American La France 280
Bell & Howell Company 287
Electric Storage Battery Company 273
Fairchild Aviation Corporation..... 270
Imperial Brass Mfg. Company 282
Irving Air Chute Company..... 274
Johnson & Johnson 275
Walter-Kidde Company 282
Leece-Neville Company 287
Nicholas Beazley Company 284
Pyle-National Company 276
The Rubbercraft Corporation 279
Switlik Parachute & Equipment Co... 276
Willard Battery Company 277

THE FOLLOWING MANUFACTURERS OF ACCESSORIES AND MATERIALS ARE NOT LISTED IN THE DIRECTORY

Airport Equipment: Allith-Prouty Company, Danville, Ill.; Armco Culvert Mfgrs. Assn., Middletown, Ohio; The Austin Company, Cleveland, Ohio; S. F. Bowser & Company, Fort Wayne, Ind.; The Truscon Steel Company, Youngstown, Ohio.

Airplane Parts: Brewster Aeronautical Corporation, Long Island City, N. Y.; Haynes-Stellite Company, Kokomo, Ind.

Bearings: Allison Engineering Company, Indianapolis, Ind.; The Federal-Mogul Corporation, Detroit, Mich.

Fuel and Lubricants: Associated Oil Company, San Francisco, Cal.; Barnsdall Refineries, Inc., Tulsa, Okla.; Cities Service Company, N.Y.C.; Phillips Petroleum Company, Bartlesville, Okla.; Richfield Oil Company, Los Angeles, Cal.; Sinclair Refining Company, N.Y.C.; Skelly Oil Company, Tulsa, Okla.; Tidewater Oil Company, N.Y.C.; Wolverine-Empire Refining Company, N.Y.C.; Valvoline Oil Company, Cincinnati, Ohio.

Instruments: Julian P. Friez & Sons, Baltimore, Md.

Material and Fabricated Parts: Allegheny Steel Company, Breckenridge, Pa.; American Brass Company, Waterbury, Conn.; American Non-Gran Bronze Company, Berwyn, Pa.; The Laidlaw Company, N.Y.C.; Libbey-Owens-Ford Glass Company, Toledo, Ohio; Oakite Products Company, N.Y.C.; Pittsburgh Plate Glass Company, Pittsburgh, Pa.; J. V. G. Posey Company, Hoquiam, Wash.; Schumacher & Company, N.Y.C.; Shelton Looms, Sidney Blumenthal & Company, N.Y.C.; Titanine, Inc., Union, N. J.; The Zapon Company, N.Y.C.

Power Plant Parts: Barnes - Gibson-Raymond, Inc., Detroit, Mich.; McQuay-Norris Mfg. Company, St. Louis, Mo.; Moore Drop Forging Company, Springfield, Mass.; Motor Development Corporation, Newark, N. J.; The Perfect Circle Company, Hagerstown, Ind.; United American Bosch Corporation, Springfield, Mass.; Victor Mfg. and Gasket Company, Chicago, Ill.; Wallace Barnes Company, Bristol, Conn.

Radio: The Lear Development Corporation, Glenview, Ill.

Propellers: American Propeller Company, South Bend, Ind.

Tires: Firestone Tire & Rubber Company, Akron, Ohio.

Tools: Brunner Manufacturing Company, Utica, N. Y.; Greenfield Tap & Die Corporation, Greenfield, Mass.; Haynes-Stellite Company, Kokomo, Ind.; Independent Pneumatic Tool Company, Chicago, Ill.; Manly Manufacturing Company, Bridgeport, Conn.

Miscellaneous Parts and Accessories: Air Specialties, San Mateo, Cal., Folmer-Graflex Corporation, Rochester, N. Y.; E. B. Meyrowitz, Inc., N.Y.C.; Straus & Buegeleisen, Brooklyn, N. Y.

Codes for aviation

Aircraft manufacturing and air transport draft their industrial constitutions

CODING is the order of the day, and the aviation industry is in step. Under the provisions of the National Industrial Recovery Act it becomes an obligation upon each industry, normally acting through its trade association, to draft a body of rule covering the wages and hours of labor, the conditions of employment, and such limitations upon unfair competition and such stipulations of trade practices as may seem likely to promote efficiency, economy, and integrity within the industry. Upon approval by the President of the United States, such a body of stipulation and restriction and agreement and guarantee becomes definitely a part of the law of the land. Violations of the terms of the code thereafter become offenses against the Federal Government, to be punished through the Federal Courts. Manifestly nothing has ever been more important to American business than that these codes shall be clear in their provisions and reasonable in their content and that they shall go as far as possible towards clearing up the industrial abuses and waste that may have existed. The completion of a code in any industry is about the biggest piece of news that that industry has ever had, for it directly affects every single employee in the industry's firms and every consumer of its products.

The Aeronautical Chamber of Commerce, as trade association of the aircraft industry, has acted. Codes for aircraft manufacturing and for air transport operation, first drafted by the Chamber's board of governors and then worked into a more finished form in conference with representatives of all the major interests in each group, have been submitted to the Recovery Administration. If they follow the normal course, they will be further modified and perfected after analysis by various sections of General Johnson's organization, and after conference between representatives of the industry and the deputy administrator who may take this particular problem in charge (it will be R. W. Lea, former president of the Moline Plow Company, for aircraft manufacture, and Malcolm Muir, president of the McGraw-Hill Publishing Company, for air transportation) and with labor advisers and other groups particularly concerned. On getting to that stage, a public hearing will be called (already announced for August 31 for transport, and probably about Sept. 10 for manufacture) and after that the codes will be given effect on approval by the President. If all goes well, the aircraft and air transport industries should be operating under the terms of their new charters by the early part of October.

Of course two codes can't cover the whole aeronautical field. Though the aircraft manufacturing code seems to be intended to extend over the making of all aeronautical accessories (except of course those already covered by other codes) some of them will no doubt be found to need special treatment. Certainly special treatment will be needed for the operators of aircraft other than the transport lines, for at present there is no provision at all for them. Flying schools and fixed-base operators are in the aggregate large employers of labor and they will need an NRA charter of their own. Airports, too, may need one, and the airport section of the Chamber of Commerce is already working on a draft. The number of codes that have received final Presidential approval is already well over a dozen, and fully a hundred have had that temporary and limited approval implied in allowing the members of the industry concerned to substitute the provisions of their codes on wages and hours for the requirements of the so-called "blanket code" in qualifying for the Blue Eagle. A body of experience and precedent has been accumulated which makes it possible to prophesy, much more accurately than one could hope to a month or so ago, what the Administration's attitude will be on various specific questions and what will be considered as admissible in a code.

Code for the Aircraft Manufacturing Industry

ARTICLE I

This Code is adopted pursuant to the National Industrial Recovery Act. It is presented by the Aeronautical Chamber of Commerce of America, Inc., the recognized trade association of the aircraft manufacturing industry, and shall apply during the period in which the NRA is in effect. It has been approved and agreed to by the Aircraft Manufacturing Section of said Chamber. Its purpose is to effectuate the policy of the NRA in so far as applicable to this industry.

ARTICLE II

Section 1. The basic processes in the aircraft manufacturing industry are of a continuous character and cannot be changed in this respect without serious adverse effect on production and employment. Having this in mind, and with the exception of executives, or those employed in technical work and other supervisory and/or administrative positions, emergency and maintenance work, no member of this Code shall employ any worker for more than an average of forty (40) hours per week for fifty-two (52) weeks.

Section 2. No member of this Code shall knowingly employ any person under sixteen (16) years of age.

Section 3. Pursuant to subsection (a) of Section 7 of NRA, and so long as this Code shall be in effect, this Code shall be subject to the following conditions:

(a) That employees shall have the right to organize and bargain collectively through representatives of their own choosing, and shall be free from the interference, restraint or coercion of employers of labor or their agents, in the designation of such representatives, or in self-organization or in other concerted activities for the purpose of collective bargaining or other mutual aid or protection;

(b) That no employee and no one seeking employment shall be required as a condition of employment to join any company union or to refrain from joining, organizing or assisting a labor organization of his own choosing; and

(c) That employers shall comply with the maximum hours of labor, minimum rates of pay, and other conditions of employment, approved or prescribed by the President.

Section 4. The plants of the industry are open to capable workmen without regard to their membership or non-membership in any organization.

ARTICLE III

Section 1. Until changed by amendment of this Code, the minimum rates of pay per hour which shall be paid for labor in this industry by members of this Code shall be not less than forty (40) cents per hour, unless the hourly rate for the same class of work on July 15, 1929 was less than 40 cents per hour, in which latter case they shall be not less than the hourly rate on July 15, 1929, and in no event less than thirty (30) cents per hour. It is agreed that this paragraph establishes a guaranteed minimum rate of pay.

Section 2. Members of this Code agree not to pay any of the following classes of employees—accounting, clerical, banking, office, service, or sales employees (except outside salesmen) in any office, department or establishment, or in any other place or manner—less than $15 per week in any city over 500,000 population, or in the immediate trade area of such city; nor less than $14.50 per week in any city of between 250,000 and 500,000 population,

or in the immediate trade area of such city; nor less than $14 per week in any city of between 2,500 and 250,000 population, or in the immediate trade area of such city; and in towns of less than 2,500 population to increase all wages by not less than 20 per cent, provided that this shall not require wages in excess of $12 per week.

Section 3. Any attempt to evade the minimum rates of wages by improper designation of employees as apprentices or semi-skilled workers, or by other methods, shall be a violation of this Code.

ARTICLE IV

Where, prior to the effective date of this Code, any member of this Code had contracted to purchase or supply articles, materials, and/or services at a fixed price to be delivered during the period of this Code, an appropriate adjustment of such fixed price will be made to equal any increase in cost caused by the operation of the National Industrial Recovery Act.

ARTICLE V

No member of this Code shall sell, offer to sell, or make aircraft, aircraft engines, aircraft parts and/or accessories from another member's design data, drawings or copies thereof, whether patented or not, in any competitive way prejudicial to the interests of the original producers thereof unless directly and specifically licensed by the owner thereof so to do; nor shall any such member sell a license to make, have made or sell any such aircraft, aircraft engines, aircraft parts and/or accessories to another, without definite and separate agreement in writing providing equitable compensation to such owner directly and specifically for such license.

This provision is unique. So far as we have discovered, there is nothing like it in any other code that has been submitted, and it meets a special problem of recognition of design right. That the general arrangement of an aircraft design cannot be satisfactorily protected by patents has always been a sore subject with aircraft manufacturers, both of military and of commercial planes. This code will make it definitely an unfair practice to accept an order to build from a design developed by another manufacturer, whatever the circumstances or whatever the inducements to undertake such work, without the consent of the design's originator. The acceptance of such a provision would put the American industry more nearly on a footing with those of the major European countries, where it is the common rule that contracts to build from a single new design may be distributed among a number of manufacturers, but with a definite provision that a royalty is to be paid to the originator of the type on each machine built. In this country the industry has never felt that it had any such assurance against simple appropriation of design, and although actual cases of appropriation or of an order for one manufacturer to build planes from the design of another have been rare, the possibility of their reappearing has been a constant source of anxiety which the code, if accepted in its present form, promises to dispel.

ARTICLE VI

Failure to comply with any of these Articles shall be a violation of this Code.

ARTICLE VII

The effective date of this Code shall be ten days after its approval by the President of the United States.

IN LOOKING at the code as a whole it shares with a great proportion of the other codes that have been submitted a remarkable degree of silence on the subject of trade practices. The National Industrial Recovery Act was passed with the clear intention of giving every industry a chance to put its own house in order, to draft its own constitution, to eliminate "chiseling," and unfair competition, and commercial bribery, and secret rebates, and unreasonable credit terms, and other abuses. Each industry was to be allowed to get together to do things that had never been permitted before, as a reward for providing higher wages and shorter hours. It has turned out, and the fact has occasioned a deal of astonishment in Washington, that in many industries there either were no abuses or this is not considered a satisfactory way of rectifying them, for many of the codes make no attempt to deal with the subject. The aircraft code, except for the inclusion of the design-right provision of Article V, is a case in point. It may of course be amplified later, and the NRA has been spurring all industry on to get its agreements on hours and wages in shape as quickly as possible, but it is something of a surprise to find so few trade practice and fair competition items that the industry could agree upon as desirable for immediate inclusion.

The second surprise comes in the absence of any mention of a Code Authority or of any provision for enforcement of the code or for supervising further development within the industry itself. It may almost be taken for granted in the light of precedent that a Code Authority of some kind will be set up by Presidential proclamation in giving final approval, if not before, for it is apparently to be the common rule that each industry will have a committee composed of a number of members selected from within its own ranks and of three appointed by the President to supervise the collection of the necessary statistics and other information, to hear complaints of violation, and in general to watch the code and decide what ought to be done with it.

Code for the Air Transport Industry

AIR TRANSPORT is in an exceptional position in relation to the NRA. It is one of the relatively few industries that has been growing since 1929 and that has a larger employment now than it did at the beginning of the depression. A strict application of the general NRA rule of restoring 1929 employment in each industry would call for no changes of hours at all in this case, but in practice it is recognized that some industries can't possibly get back to their 1929 figures and that others more happily situated or more rapidly growing will have to take up the slack. Even a new industry, therefore, is expected to make its cut in hours and to increase its total personnel correspondingly. Air transport is unusual in another respect in that it is concerned with furnishing a service and not with manufacturing, that over-production is accordingly impossible, and that its principal competitor seems to be immune from any dealings with the NRA.

The text of the code follows:

This Code is adopted pursuant to the National Industrial Recovery Act. It is presented by the Aeronautical Chamber of Commerce of America, Inc., the recognized trade association of the air transport industry, and shall apply during the period in which the NRA is in effect. It has been approved and agreed to by the Air Transport Section of said Chamber. Its purpose is to effectuate the policy of the NRA in so far as applicable to this industry.

ARTICLE I

The term "air transport industry" as used herein includes the carriage by aircraft of passengers and/or mail and/or cargo on scheduled operations.

The term "employees" as used herein means all persons employed in the conduct of such operations.

The term "employers" as used herein means all persons, partnerships, associations and corporations in the air transport industry by whom such employees are employed.

The term "Chamber" as used herein means the Aeronautical Chamber of Commerce of America, Inc., a trade association, having its offices at No. 22 East 40th Street, New York City.

The term "effective date" as used herein means the tenth day after this Code shall have been approved by the President of the United States.

ARTICLE II

The newness of the industry and the peculiarities of its requirements in the recognition of demands of continuous operation, emergency maintenance and repair work, highly skilled personnel, irregular hours of duty, and seasonal conditions to which this industry is subjected, must be recognized. The demand on the industry arising from its traditional obligation in the carriage of United States mail and moral obligation for the safe transportation of persons trusting themselves to its care, cannot be treated in the same manner as the demands of the manufacturing industry.

These points, some of which we have already alluded to, deserve special emphasis. In a sense a transportation enterprise, and particularly a new enterprise still in the stage of rapid development, confronts a continuous emergency. The service must go on regularly, and safely, and efficiently, and every other consideration, including the desire to adhere to a fixed schedule of hours of labor must be subordinated to that.

ARTICLE III

On and after the effective date and to and until the expiration date, hours of labor will not be more, and rates of pay will not be less, for the following employees in the Air Transport Industry than:

Pilots: An hourly or monthly rate for flying with a guaranteed minimum of $250 per month. Maximum hours of flying, 110 hours per month.

Co-Pilots: $150 per month, minimum rate. Maximum hours of flying 150 hours per month.

Cabin Attendants: $100 per month, minimum rate. Maximum hours per month 150.

Shop Mechanics: $0.40 per hour, minimum rate. Average 40 hours, 52 weeks, maximum 48 hours in any one week.

Clerks: $15 per week, minimum rate. Maximum hours per week, 40.

Outside Salesmen: $100 per month, minimum rate. Maximum hours per week, 48.

Radio Operators, Service Mechanics, Field Clerks: $80 per month, minimum rate. This class of Air Transport employees is paid by the month and no specific number of hours definitely stipulated because of the intermittent nature of its work and active duty.

Apprentices, Washers, Helpers, Porters, Office Boys, Janitors and Watchmen: Minimum rate, 30 cents an hour, maximum hours, 40.

The foregoing provisions shall not apply to persons employed in a professional, managerial, or executive capacity, who now receive more than $35.00 per week, nor to employees on emergency operations, maintenance and repair work.

ARTICLE IV

Employers in the air transport industry shall not employ any person under the age of sixteen years.

ARTICLE V

As required by Section 7 (a) of Title I of the National Industrial Recovery Act the following provisions effective until the expiration date are conditions of this Code:

(a) That employees shall have the right to organize and bargain collectively through representatives of their own choosing, and shall be free from the interference, restraint, or coercion of employers of labor, or their agents, in the designation of such representatives or in self-organization or in other concerted activities for the purpose of collective bargaining or other mutual aid or protection; (b) That no employee and no one seeking employment shall be required as a condition of employment to join any company union or to refrain from joining, organizing, or assisting a labor organization of his own choosing; and (c) that employers shall comply with the maximum hours of labor, minimum rates of pay, and other conditions of employment, approved or prescribed by the President.

The selection, retention and advancement of employees will be on the basis of individual merit without regard to their affiliation or non-affiliation with any organization. Nothing herein shall impair the constitutional right of employers to the freedom in the selection, retention and advancement of employees.

ARTICLE VI

Members of the Code agree not to initiate service between cities already served by another member over an identical route.

The provision against new competition, like that against building from another manufacturer's design without having received his license, is almost unique. Though there seems to be very strong reason for such a provision in order that air transport may be efficiently developed on a national basis with a minimum of strength wasted in duplicated or triplicated effort by competing services on a few popular routes, and though a stronger case can probably be made from such a provision in air transport than in almost any other field, it remains to be seen just how a flat rule against new entries along established routes will be received in Washington. There may be some question of its feasibility under the section of the Recovery Act which prohibits any use of its provisions to establish monopoly. Up to the present time it has been the policy of the NRA to avoid any action, or any language in codes, that will open the way to possible protracted legal arguments. Article VI, however plainly desirable it is from the point of view of improving air transport service to the American people, may be suspected as possibly inviting law suits from belligerent newcomers who may find themselves debarred from the routes that their fancies favor.

ARTICLE VII

Under Section 2 (a) of Title I of the National Industrial Recovery Act, the Chamber is hereby appointed an agency for the following purposes:

(a) To collect from the members of the air transport industry all data and statistics called for by this Code, or required by the President, or reasonably pertinent to the effectuation of Title I of said act, and compile the same, and disseminate among the members of the air transport industry summaries thereof, and allocate among and collect from the members of the air transport industry the expenses necessarily and reasonably incurred in the preparation and presentation of this Code and by the agency in exercising its duties under this Article VII, all in such form and manner as said agency shall reasonably prescribe.

(b) To represent the air transport industry in conferring with the Administrator with respect to the application of this Code and of said Act and any regulations issued thereunder, and to hear complaints and if possible adjust the same, and to coordinate the administration of this Code with such codes, if any, as may affect any subdivision of the air transport industry or any related industry, with a view to providing joint and harmonious action upon all matters of common interest, and to receive any proposals for supplementary provisions or amendments of this Code or additional codes applicable to the air transport industry or various subdivision thereof, with respect to wages, hours, trade practices or any other matters affecting the air transport industry or any subdivision thereof, *provided, however,* that as regards all matters mentioned in this paragraph (b) said agency shall have no power to express any approval or recommendation to the Administrator, or in any way bind the air transport industry or any subdivision thereof, or do any more than consider the foregoing matters, and confer with the members of the air transport industry affected thereby, with a view to developing the sentiment of the air transport industry, and the arguments for or against such proposals, and arrange for hearings before the Administrator on any proposal which a substantial proportion of the air transport industry desires to present.

(c) The duties of said agency above enumerated shall be exercised by the Chamber by action of its Board of Governors and/or members, as provided in its certificate of incorporation, constitution and by-laws and the laws under which it is incorporated. Said agency may delegate any of its duties to such agents and committees as it may appoint whose personnel, duties and powers may be changed by said agency from time to time.

This is the Code Authority, the absence of which in the manufacturing code has already been remarked. Very likely it will develop, as in other codes so far approved, that the President will insert a provision giving him the right to appoint one or more members to sit with the Chamber's board of governors in matters relating to the code. It is perhaps a little surprising to find the responsibilities for the supervision of the air transport code referred to the Chamber as a whole, or to the board of governors as a whole, since many of the members of the Chamber and several of the board have no direct connection with and presumably no special knowledge of air transport.

ARTICLE VIII

When prior to the effective date of this Code any member of this Code had contracted to furnish or supply articles, materials and/or services at a fixed price to be delivered during the period of this Code, an appropriate adjustment of such fixed price will be made to equal any increase in cost caused by the operation of the National Industrial Recovery Act.

ARTICLE IX

As required by Section 10 (b) of Title I of the National Industrial Recovery Act, the following provision is contained in this Code: The President may from time to time cancel or modify any order, approval, license, rule or regulation issued under this title.

ARTICLE X

It is contemplated that supplementary provisions or amendments of this Code or additional codes applicable to the air transport industry or various subdivisions thereof may from time to time be submitted in behalf of the air transport industry or various subdivisions thereof for the approval of the President.

New suburbs for New York

Two serious attempts to provide seaplane service with terminals near the heart of New York City

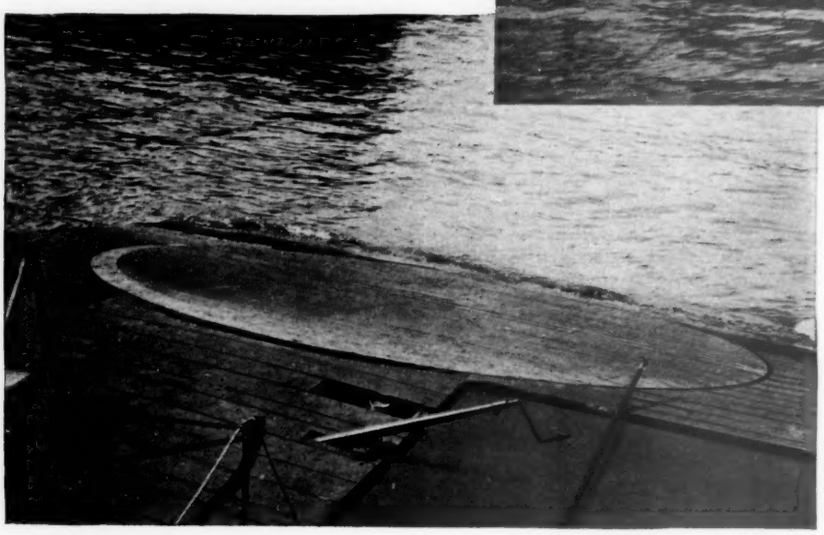
A DISGRUNTLED ferryboat captain, guiding his craft with some dexterity through the congested traffic of the lower Hudson, reached for the indicator handle of the highly polished engine room telegraph and gave the signal for full speed astern. With a remark in an undertone about needing windows in the roofs of pilot houses, he maneuvered his charge in the difficult current to make way for the landing of the Friday evening plane of the Island division of Maine Air Transport. Meanwhile the passengers awaiting the airplane on Pier 14 divided their interest between the complication of river traffic and the process of launchng the specially designed retractable landing stage from the pier.

Several minutes before the arrival of the Wasp-powered Fairchild the landing float stage, which is about 6x12 ft., was hoisted from its berth on the dock and dropped into the water, carrying with it the sliding gangway connected to the pier. After the last plane of the evening has departed, the float stage is hoisted back into its place on the dock to make way for the outgoing passenger boats of the New England Steamship Lines and the New York, New Haven, & Hartford Railroad, in co-operation with which the service is operated. The pier is conveniently located with respect to all points in the city (five minutes by taxicab from Wall Street) and the new line offers three-hour week-end service to Nantucket, Martha's Vineyard, Newport and Cape Cod. In addition to the regular out-bound service on Friday and Saturday, with return on Monday, daily service is provided to Saratoga and return during the Saratoga race meet, and special charter trips can be arranged to such points as Southampton, the Adirondack lakes, and other summer resorts.

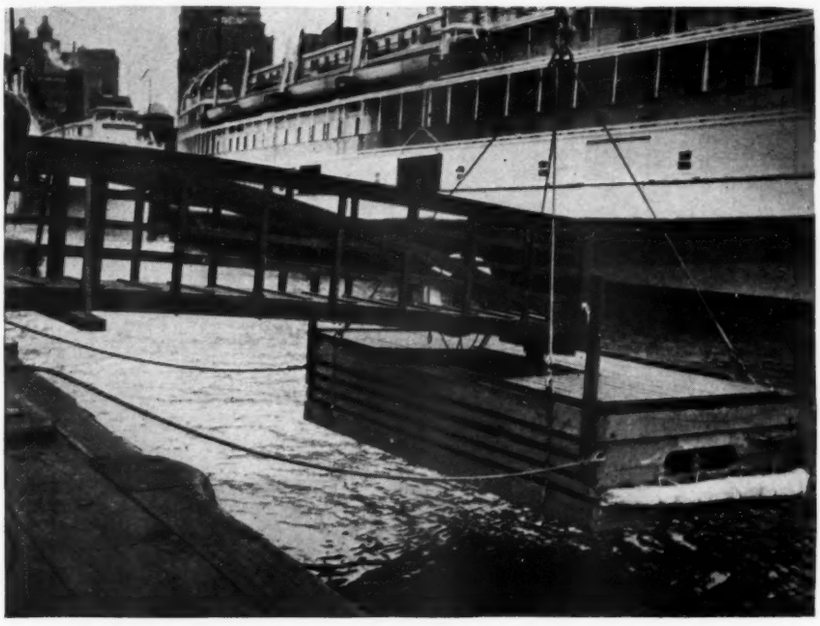
The Friday evening schedule to Nantucket is usually in three sections, of course depending on the number of passengers booked. Passengers are grouped in the several sectors in such a way that no unnecessary stops are made. Saturday afternoon schedules begin just after noon, and are usually in two sections. On the return trip Monday morning, from Nantucket departure is at 6:30 and arrival in New York at 9:30. Three sections usually suffice as some of the passengers return by night train. One-way fares range from $12 to Fisher's Island to $22.50 to Nantucket.

A Whirlwind-powered Travelair seaplane is used in the daily service to Saratoga, which is patronized largely by close followers of horse racing. The regular departure from New York is at noon, with arrival at 1:40 p.m. The return plane leaves following the last race with scheduled arrival in New York at 7:40. The round-trip fare is $25. It frequently happens that passengers to Saratoga wish to proceed to various Adirondack lake resorts and special charter connections are often made for these points.

The planes are equipped with radio, and teletypewriter connection is provided between the stations. At Woods Hole, Vineyard Haven, and Nantucket, the regular steamship wharves are used as landing-stages. Tickets are sold at all the offices of the New England



Above: Metropolitan Seaplane Terminal. The Waco is tied to the turntable in position for loading and launching. Below: Looking down on the turntable at the Metropolitan Seaplane Terminal. The crank in the foreground operates the differential gearing.



The retractable landing float of Maine Air Transport in the process of being lowered into the Hudson River from the south side of Pier 14.

Steamship Lines. The general manager is Robert Bell and the chief pilot Harold Moon of Island Airways division, Maine Air Transport. Operations for the summer will be suspended Sept. 15.

Maintenance work is carried out at the seaplane base at Port Washington, Long Island, 20 miles out of New York, and at the present time all equipment is based there.

A permanent seaplane base

The Hudson River, however, is to have a permanent seaplane base of its own, and it is rapidly approaching completion as this issues goes to press. Directly across the river from Hudson Terminal and located at Pier B, Jersey City, just a stone's throw from the Exchange Place station of the Hudson Tunnels and ten minutes from the New York financial district, is the Metropolitan Seaplane Terminal of Marine-Air Transport Company. In addition to the stations of the Hudson Tunnels and Pennsylvania Railroad ferries, both located in Exchange Place, the seaplane base is easily reached by automobile from the Holland Tunnel entrance and the terminal of the high-level viaduct which connects Jersey City with Newark. Provision has been made for automobiles to drive out to within a few feet of the offices and waiting rooms.

Because of the greater distance between piers on the New Jersey shore, there is opportunity there for a permanent float and ramp. The Metropolitan Seaplane Terminal is built on a large Navy barge, 164 ft. in length and moored to the north side of Pier B. The forward portion is devoted to an observation deck and passenger terminal in carefully executed nautical design, and including executive offices and restrooms. Restaurant facilites are available in the Pennsylvania ferryhouse nearby.

For passenger handling, a floating ramp of the inclined-turntable type is attached to the side of the barge some distance below the deck level and reached from the observation deck by a permanent stairway and gangplank. The ramp is so ballasted that the inclined portion of its deck containing the turntable is inclined at an angle of approximately 15 deg. and a circular turntable, planked with wood and having a diameter of about 25 ft., is installed on the inclined portion of the ramp surface. The turntable moves through an arc of 360 deg. and is manually operated by a crank-handle transmitting the drive through an ordinary automobile differential gear. A ramp and turntable having some of these features were designed some time ago by B. V. Korvin-Kroukovsky, chief engineer of Edo Aircraft Corporation.

Service facilities

In the service section of the barge, to the rear of the passenger deck, another method of handling seaplanes is provided. The seaward side of the barge has been cut away and a long inclined ramp provided on which the plane can be hauled out on dollies or a handling-truck. Complete service facilities and a supply of gas and oil are now provided for visiting planes. Ample water area for mooring ships is also available.

There is an advantage in a landing area on the New Jersey shore in that it is far removed from the main channel of the Hudson and therefore less likely to be handicapped by traffic congestion. Even the seaplanes having the New York shore for their objective are more likely to find clearer landing space off the Jersey shore and to taxi over to the New York terminal. Prevailing winds during the months of May to September are southerly and south-westerly, so that take-offs during the busiest months of the year can be made down the bay, where the traffic is lighter than to the north of the terminal. The ramp and floats are located well out of the current, which in any case never exceeds 1.7 knots.

Commutation and charter

In addition to its operation of the new seaplane base, Marine-Air Transport Company also plans to operate commutation and charter service to several summer resorts, including the New Jersey and New York lakes and certain of the seashore resorts. A Continental-powered Waco cabin plane on floats has been purchased, and is already being used extensively in charter service. The company also owns and very shortly will place in operation two of the Savoia-Marchetti flying boats (two 550 hp. Isotta-Fraschini engines) which are similar to those used by General Balbo on his recent flight. Officers of the company are Edwin R. Closs, president, Rodney H. Jackson, operations manager and chief pilot, F. H. Colby, traffic manager, and F. R. Becker, terminal manager.

Marine-Air Transport plans to operate during the fall and during the winter months, with the ultimate objective of all-year service and commutation facilities between its metropolitan base and the lake resorts. Arrangements already have been made for outlying terminal facilities at these places, and several new services are planned for next spring.

Subway to summer resort

These two efforts mark the first serious attempt to provide permanent landing facilities in the heart of New York City or within a few minutes travel by subway from the city's center. They appear to offer attractive possibilities, and they are of special interest for their part in the effort that is being made to bring the more remote summer resorts closer to metropolitan New York and to make air commutating an established fact. Many other cities—Chicago, Milwaukee, Boston, Seattle, and Detroit come to mind as good examples—may be able to do the same thing with seaplane services of their own. Still others —Los Angeles, for instance—can run commuter schedules to resorts with landplanes, and it would be well worth while in many cases for resort hotels and real estate interests to subsidize such operations.

Seven days of bad weather

Record of Wiley Post's Round-the-World Flight

	(Miles) Distance	Total Flying Time Hr.	Min.	Length of Stop Hr.	Min.	Total Elapsed Time Hr.	Min.	Average Speed	Point-to-point Flying Time Hr.	Min.
New York-Berlin.....	3,942	25	45	2	15	28	..	153.1	25	45
Berlin-Koenigsberg.....	340	30	15	13	5	44	35	75.6	4	30
Koenigsberg-Moscow...	651	35	50	1	52	53	12	116.6	5	35
Moscow-Novosibirsk....	1,579	49	5	2	5	69	2	119.2	13	15
Novosibirsk-Irkutsk. ...	1,055	55	38	15	25	91	..	161.1	6	33
Irkutsk-Rukhlovo.....	750	63	10	9	3	107	25	99.6	7	32
Rukhlovo-Khabarovsk .	650	67	30	2	13	113	58	150.1	4	20
Khabarovsk-Flat.....	2,800	90	02	15	58	152	28	124.3	22	32
Flat-Fairbanks.....	375	93	16	7	3	162	45	116.1	3	14
Fairbanks-Edmonton...	1,450	102	38	1	33	173	41	154.7	9	22
Edmonton-New York...	2,004	115	54	..	..	186	57	151.0	13	16
Total distance.....	15,596	115	54	71	3	186	57	134.6	115	54

FIVE minutes after taking off from Floyd Bennett Field on his record-breaking solo flight around the world Wiley Post had his first taste of blind flying, but conditions improved until he was half-way across the ocean. From that time until the last half of the last leg of the flight the weather was almost continuously bad. He characterized the seven days as the worst collection of weather in all of his long flying experience. Such a flight provided an excellent opportunity to prove the usefulness of the various special devices installed on the Winnie Mae, including the variable-pitch propeller, automatic pilot, and radio compass.

Through the installation of a manifold pressure gage to determine horsepower output of the engine at high altitudes it was possible to check on the performance of the variable-pitch propeller, and it was found that air speed could be increased at high altitudes while the engine's power output remained constant. At 15,000 ft. a cruising speed of 200 miles per hour was reported. A number of pitch settings were used and were selected to a nicety and the full range of variation was required. The problem of takeoff with a full load of fuel was also materially simplified.

Installation difficulties in the form of a leaking hose connection in one of the hydraulic pressure lines rendered the automatic pilot inoperative for the most part in the first stages of the journey, but the tube joint was silver soldered in Russia and from that time to the end of the flight the automatic pilot functioned perfectly. Complete exhaustion, however, did not overtake Post until the last leg of the flight, during which he got several brief snatches of sleep and depended completely on the automatic pilot to guide the ship. An improvised alarm consisting of a piece of string looped around his finger and attached to the control stick was rigged up as a warning device to awaken him if the airplane should encounter rough weather. In order to provide a variety of positions to rest the hand and arm, an offset extension was fitted over the end of the stick and fastened by a set screw. This arrangement made it possible to fly with either hand and with the flying arm in the most restful position and could be quickly detached when it was necessary to make a landing.

In addition to the usual equipment for navigation, the Winnie Mae was equipped with a homing variety of radio compass developed and furnished by the Army Air Corps. While details of the operation of this device are not available at the present time, it is understood that it is similar in operation to the Kruesi compass, which, when tuned to any broadcasting station near the objective, indicates through a simple visual-type indicator any departure to the right or to the left from a direct course to the broadcasting station.

Radio an aid

Particular assistance was rendered by stations VOWR, St. Johns, Newfoundland; G2LO, Manchester, England; CFAC, Calgary; CJCA, Edmonton, and CKY, Winnipeg, Canada, and WBBM, Chicago, all of which arranged special broadcasts of weather information. In the run from Khabarovsk to Fairbanks broadcasts were arranged by three signal corps stations at Teller, Nome and Hot Springs. The broadcasts of the British Meteorological Bureau information by G2LO, Manchester, were particularly helpful in the transatlantic section of the trip and were picked up after passing Cape Race.

The engine was the regular power plant of the Winnie Mae modified to conform with S1D1 Wasp specifications of 550 hp., and with 6:1 compression ratio, but using a Size 7 instead of a Size 8 carburetor for economy, and equipped with thermocouples as in the previous flight. A 10 to 1 blower gear ratio was used in the supercharger impeller. For purposes of economy a hot-air stove was installed on the exhaust manifold to heat the front end of the engine and a temperature indicator was provided for the blower section to keep it at constant temperature and to avoid ice formation.

Few fundamental changes were made in the internal arrangement of the Winnie Mae. A tail tank was installed in the space formerly occupied by the navigator, bringing the capacity up to 650 gal. of fuel, and an arrangement was made whereby gasoline could be pumped into the tail tank to help get the tail down in landing. Each leg of the journey was concluded with a generous reserve supply of fuel.

External changes in the Winnie Mae included a decrease in incidence of the wing even greater than that employed in the previous round-the-world flight, and a special landing gear in which a triple shock cord was substituted for the usual oleo strut.

Ethyl fuel was standard. In Russia, Post did the final blending.

EDITORIALS

AVIATION

EDWARD P. WARNER, *Editor*

World wide markets

THIS ISSUE of AVIATION is frankly devoted to the endeavor to find new markets for American aeronautical products. In order that such an endeavor may be worth while, certain conditions must be met. The products must be good enough to maintain the market on their own merits after an opening has once been found for their acceptance on a trial basis. They must be adapted to the conditions that they will have to encounter in foreign fields. And finally, but by no means least in importance, there must be an open market and a willingness to allow foreign trade to exist.

Upon the first points we have enlarged at length in the opening pages of this issue. We have reviewed the highest spots in the record of experience with American airplanes and engines and accessories under foreign flags. We have indicated some of those special features of American operating conditions which require the American manufacturer, if he is to succeed at home, to develop a product capable of standing for all the forms of hard service and abuse to which it would be subject in any other part of the globe.

But the third of our indispensable conditions, the one that relates to the existence of an open market and of a free flow of international commerce, we have not so far touched. At that point we must address ourselves particularly to our foreign readers. It is the responsibility of the American industry to build an article that deserves to be sold abroad and that will give satisfaction if it is so sold, and then to offer it at a fair price. All that would be of no avail, however, if the potential foreign purchaser has already made up his mind to do his buying on purely nationalistic lines, or if barriers have been put in the way of free commerce.

We of AVIATION start with a frank recognition that trade between America and Great Britain or Italy or Japan must be as much a matter of mutual exchange as the trade between New York and Kansas. When we undertake to stand behind the efforts of the American industry to find a foreign market for its products we recognize without question the necessity of finding a market here for foreign products received in exchange. That is the obligation at once of good neighbors and of intelligent business men. It is not affected by temporary variations in prices or wage rates or by fluctuations of the gold value of currencies.

Such matters as those will adjust themselves if governments will give them a chance. Fair competition will enable every industry to find its own level. What we shall always object to, whether it happens in America or on the other side of the world, is a disposition to set up artificial barriers to trade by such devices as disputing about the lack of absolute identity of the airworthiness rules of the nations concerned.

We have long advocated, and the representatives of the American government have repeatedly endeavored to secure, general reciprocal agreements with other nations providing for mutual recognition of each other's standards and for mutual admission of each other's products. Such agreements have been concluded in a handful of cases. In other instances, however, an apparently infinite series of technical obstacles have arisen. We cannot know all the facts in every such instance, but we do know that the whole record in the case makes it absurd to suppose that American aircraft and the parts that enter into them are unsafe, or that the standards of safety are any lower in America than anywhere else in the world. To exclude American products from the market of any nation because they happen to have been inspected by the representatives of the Department of Commerce instead of by the officials of the nations concerned is a palpable absurdity, and a check upon international trade far more serious than those introduced even by the most stringent quotas. Unless the ultra-nationalism that has afflicted some countries, and that has seized upon every possible occasion for making the way of the foreign manufacturer hard, can be checked any attempt to promote foreign trade becomes a hollow mockery.

We of AVIATION feel some confidence that a considerable number of the products of the American aeronautical industry are so good that there is a definite need for them in foreign countries, and we want to see conditions set up that will at the same time make it possible for our products to go where they can be useful and where they are wanted, and for foreign products that may particularly fit some requirement of our own to come freely into our own service. Where the aeronautical market is an open one American goods have made a place for themselves, and their place grows in importance as rapidly as their qualities become known. Where there is no open market, a growing volume of impatience is being shown by those who have determined by careful study that they want American aircraft or engines or accessories, and who find themselves denied the privilege of buying them.

NEWS OF THE MONTH

Lights out for economy

TO CO-OPERATE with the Federal Government in its economy policy, the Aeronautics Branch called a meeting on Aug. 15 at Washington between the Airways division and representatives of users of the airways to face the problem of meeting the reduction in airways maintenance allowance to $4,347,500 for the current year. (The all-time high for all airway purposes was a $9,000,000 appropriation in 1932) Rex Martin, assistant director for airways, announced that already a saving of approximately $500,000 had been accomplished by economies in the Regulations, Airways, and Development divisions, and that the elimination of 73 landing fields alone had resulted in a net reduction in operating expense of $135,900

Among Mr. Martin's detailed proposals: rearrangements of lenses in double-ended 36-in. beacon to provide alternate white and colored flashes, doing away with course lighting—approved and effective immediately; consolidation of E.A.T.'s coastal and inland routes from Richmond to Greensboro, by eliminating lights and fields between Richmond and Florence; substitution of 500-watt bulbs for the 1,000-watt now used on revolving beacons (found by test to leave a wholly satisfactory beam intensity); boundary lights on all intermediate landing fields having permanent keeper personnel to be lighted only upon request, or when a plane is heard flying in the vicinity; radio ranges to be shut down and operated only when ceiling and visibility are bad; 1,231 miles of airways lighting to be saved by closing down the routes: Pueblo-Denver, Pasco-Spokane, San Antonio-Brownsville, New Orleans-St. Louis, St. Louis-Chicago, New Orleans-Atlanta, and Chicago-Rockford-Lone Rock; suspension of 2,000 miles of teletype circuits. The operators have been asked to make suggestions for any changes which might effect the same savings with less damage to the service.

Regulating regulations

Outstanding among the changes which the Aeronautics Branch is making for the purpose of reducing air regulation service expenditure for the current fiscal year are: permanent assignment of individual inspectors to 45 cities and concentration of license applicants at these places; consolidation of the two inspection district bases at Roosevelt Field and Camden Airport into one district, with Floyd Bennett Field (Brooklyn) as headquarters; discontinuance of the maintenance base at Bolling Field, Washington, D. C.; and complete segregation of airline inspection.

Under the new policy the Supervising Aeronautical Inspector in charge of a district will assign each inspector to a city within the district territory. Applicants for licenses and renewals will be required to contact the inspector—any traveling to be done hereafter will be done by the applicant.

Due to the fact that there are an insufficient number of inspectors for all important air centers, some will be assigned to make periodic tours away from their own headquarters, staying a day or two each month at other key points.

Requirements have been broadened in respect to the relicensing of repaired or rebuilt aircraft through a new regulation that upon approval of a licensed mechanic the repaired plane may be flown, without passengers, to the nearest inspector for inspection and relicensing.

Changes in personnel in this division find George E. Gardner the new chief of the Inspection Service; Joseph S. Marriott, former chief inspector, succeeds as supervising aeronautical inspector at Los Angeles Charles A. Rowe, who is transferred to a similar post at Dallas; C. A. Charles of Camden, N. J., and R. I. Hazen of Dallas, supervising inspectors at Camden and Dallas respectively, become school inspectors. The inspection district headquarters will be located at New York, Los Angeles, Atlanta, Detroit, Chicago, Kansas City, Mo., Dallas and Oakland.

Extending student privileges

Private flying restrictions will be greatly relaxed by the Aeronautics Branch's action in abolishing the solo pilot license. This means to the student pilot that from the day he receives his student permit until he has logged 50 solo hours and is ready to complete the required flight and written tests for his private license, he need never see a department inspector. The solo licenses now being held may be retained until expiration date, at which time they must be exchanged for the student license or the test taken for the private.

For the purpose of ascertaining the distance required by each type airplane for landing, tests of various types of civil aircraft are being conducted at Roosevelt Field by the Department of Commerce. In order to be eligible for license, civil aircraft are required by the department to remain within certain specified landing speeds, but landing runs have not been fixed.

Extending its check on the number of accidents in scheduled air passenger operation, the Aeronautics branch has issued an order that all forced landings caused by bad weather or mechanical failure be reported to the department.

The Automotive division and the Aeronautics Trade division of the Bureau of Foreign and Domestic Commerce have been consolidated into one division to be known as the Automotive-Aeronautics Trade division. A. W. Childs, former head of the Automotive branch has been placed in charge. Leighton Rogers, former head of the Aeronautics division, resigned some time ago to accept the executive vice-presidency of the Aeronautical Chamber of Commerce.

Postmaster Farley acts

By authority of President Roosevelt's Executive Council, action has been taken by Postmaster General Farley directing the use of the air mail for all but the most urgent government messages. In a message to all federal department heads, Mr. Farley called attention to the facilities offered by the Post Office department for rapid transportation of mail by air and enclosed a table showing the speed of communication between Washington and a score of the more important cities of the country.

An additional reduction of $1,000,000 in appropriations from the $15,000,000 allowed domestic air mail for the fiscal

Calendar

September	International Gliding Congress and Meeting, La Banne, d'Ordanche (Clermont Ferrand), France.
Sept. 1-4	International Gordon - Bennett Balloon Race and Air Races, Chicago.
Sept. 14	Meeting of manufacturers with Department of Commerce to consider revisions of airworthiness regulations.
Oct. 7-8	U. S. Amateur Air Pilots Association Charity Air Pageant, Roosevelt Field, Long Island, N. Y.
Oct. 12-13-14	Meeting, National Association of State Aviation Officials. Cincinnati, Ohio.
Oct. 20-21	Annual Convention, National Aeronautic Association, Washington, D. C.
December	International Rally, Cairo, Egypt.
December 14	Meeting of the Federation Aeronautique Internationale, Cairo, Egypt.
February	Viceroy's Challenge Trophy 700-mile Race–Delhi, India.
Feb. 9-13	Races—Dedication Shushan Airport New Orleans, La.

year has been made by the Post Office Department, making a total reduction of $5,460,000 from the 1932 appropriation of $19,460,000.

Protest

A number of Chambers of Commerce and other business organizations have protested against the impending air mail service curtailment. Most recent to take up the bludgeon is the Merchant's Association of New York, which in a letter to Postmaster-General Farley denominated as short-sighted economy the proposals to restrict facilities for rapid air mail deliveries.

Mid-year statistics

The mid-year statistics have arrived, and the Aeronautical Chamber of Commerce reports scheduled airlines operating in the continental United States carried a total of 229,075 passengers during the first six months of this year, an increase over the previous "banner" year of approximately 6,000 passengers. Average flights this year were longer and the passenger-miles amounted to 73,277,579, an increase of 28 per cent over the 57,654,217 in the first half of 1932. Air express with 813,353 lb. carried in the six months showed a gain of 21 per cent. Air mail poundage, still suffering under its high rate, closed the six-month period with a 16 per cent loss.

Widespread improvement is reflected in the reports from United Airlines, which carried over 15,000 passengers in July; TWA, with an increase in passengers of 55 per cent in one month; American Airways,—13,917 passengers in July; and Eastern Air Transport, registering an average of 220 passengers daily for July.

American-operated airlines flew 25,862,120 miles in the first half of 1933 with a record of only two passenger fatalities. The total number of accidents was 48, of which five were fatal, but in only two cases were passengers involved.

Truce

Secretary of Labor Frances Perkins was pleased when through a 30-day truce a threatened strike of airline pilots was postponed by the executive council of the Air Line Pilots' Association pending a thorough investigation with respect to wages and discussions between airline officials and representatives of the pilots.

Pan American trade

The Postmaster-General directly attributes recent increases in the flow of trade and commerce between the Americas to the foreign air mail service, and reports that during June, ordinarily a slow month for export activity, the main trans-Caribbean route of Pan American Airways showed the United States Treasury a net profit of 12 cents per mile. Of the current mail volume, 94 per cent represents business correspondence, and 78 out of every 100 passengers are business travelers. During 4½ years of operation the line has carried 203,000 passengers.

W. A. PATTERSON
Recently elected executive head of the operating divisions of United Air Lines, which include Boeing, N.A.T., P.A.T. and Varney Air Lines.

A recent Treasury decision permits the senatorial committee investigating foreign and domestic ocean and air mail contracts to examine the tax returns of the contractors.

Close upon Mr. Farley's statement concerning the increase in Pan American trade, Juan T. Trippe, president of the Pan American Airways announced that his company has ordered $5,000,000 to be spent in the next four years on development work. $1,000,000 will be employed immediately for a new air base at Miami, Fla. Large flying boats and other aircraft will consume the other $4,000,000 appropriation. The new equipment will be put in service on the present Pan American system and on the proposed route to Europe which Col. Lindbergh is now surveying. Immediate employment of 3,000 men will be necessary to take care of this expansive program.

Airport progress

To complete necessary repairs and improvements on the Newark Airport, Mayor Meyer C. Ellenstein of Newark will ask the NRA for $90,000 . . . A petition for the designation of Floyd Bennett Airport as the official air mail base for New York City has been sent to Postmaster-General Farley by John McKenzie, commissioner of docks, which operates the city airport . . . New airports under way are: De Leon Springs, Fla., ready for use Oct. 1; Crescent City, Cal.; Bath, N. Y.; Belle Fourche and Rapid City, S. D.; Brielle, N. J., opened Aug. 1.

More contracts

Awarded to the Pennzoil Company by United Air Lines, a contract for 300,000 gal. of lubricating oils—a year's supply. TWA has renewed with the Texas Company its entire gasoline and oil requirements for the coming year. The Goodyear Tire & Rubber Company in Akron has completed and delivered to the United States Navy 225 Navy life rafts, as standard equipment on airplanes based on carriers or used for over-water flights.

Over Greenland's ice-cap

Time-tables of trans-Atlantic airlines using the northern route will include the names of Holstenborg, Christianshaab or Godthaab on the west coast and Angmagsalik, Scoresby Sound, or Ella Island on the east coast of Greenland, if the itinerary of the survey flight being made by Colonel and Mrs. Charles A. Lindbergh is any indication. Enroute to Reykjavik, Iceland, these have served as bases for the survey flights (including a 700-mile trip across the island's notorious inland ice-cap with its 9,000-ft. peaks) which they are making for Pan American Airways.

Three continent record

Landing at Rayak, Syria, on Aug. 7 after a non-stop flight from Floyd Bennett Airport in New York, French pilots Paul Codos and Maurice Rossi set a new world's straight line distance record for airplanes. Distance, computed by the Navy Hydrographic Office according to new F.A.I. rulings, was 5,630 miles, exceeding by almost 300 miles the previous record made by Squadron Leader Gayford and Flight Lieutenant Nicholetts of the Royal Air Force. The Bleriot monoplane, powered with a 500 hp. Hispano-Suiza engine equipped with a special four-blade propeller and carrying a radio set, was in the air almost 56 hours. A 1,770-gal. fuel supply was expected to carry it to Karachi, India, but battle with North Atlantic storms proved too expensive of gasoline.

Air legions return

When two weeks of waiting brought no prospect of fair weather between Shoal Harbor, Newfoundland, and Valentia, Ireland, General Balbo led his air fleet home across the Atlantic via alternative southern route to the Azores and Portugal. After a week's rest in the waters off Floyd Bennett airport while their crews received the city's welcome, the 24 Italian flying boats had proceeded to Shediac, N. B., and Shoal Harbor, without incident. A 1,400-mile flight to the mid-Atlantic island which the NC-4 first put on the airway maps in

1919, a shorter hop to Lisbon, Portugal, and the air legions were off on the last lap to the home base and the acclaims of Il Duce and the Imperial City. Twenty-three ships made the round trip to Chicago, one having crashed in landing at Amsterdam, outward bound, another at the takeoff from the Azores on the way home.

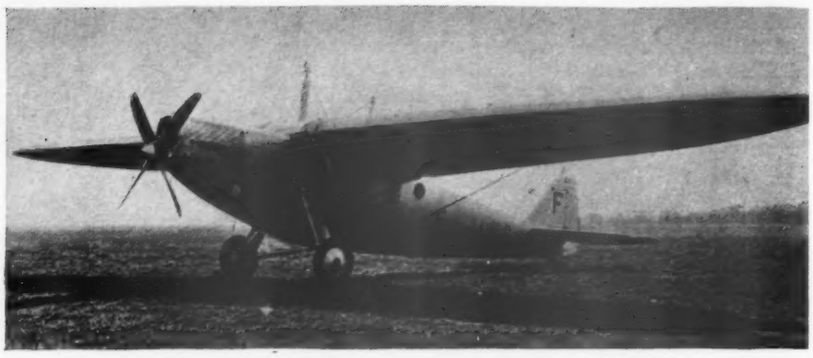
Air races

With the end of the trans-oceanic flying season in sight, the International Air Races, featuring the 21st running of the Gordon Bennett Balloon Race, dominates the air sportsman's horizon. Already entered as contenders for the Bennett Trophy which will be defended by the 1932 winner, Lt. Comdr. T. G. W. Settle, U.S.N., are representatives from Poland, France, Belgium, Germany, the U.S. Air Corps entry under Lieutenant W. J. Paul of Langley Field, Va., and the third American entry piloted by the veteran contender Ward T. Van Orman. High lights of the program of heavier-than-air events for which $35,000 prize money has been guaranteed and which has N.A.A. sanction will be the 200-mile Chicago *Daily News* Trophy Race for which the qualifying speed is 225 m.p.h. and the Labor Day Free-for-all for a $10,000 cash purse and a trophy posted by Frank Phillips, president of Phillips Petroleum Company. No list of entrants had been published, but several new racers which missed the National Air Races are expected at the barrier.

Dr. Hugo Eckener will visit this country again, when he brings the Graf Zeppelin to the World's Fair the latter part of October. The Graf will leave Friedrichshafen, Germany about Oct. 14 and proceed to Chicago via South America.

India's sporting classic, the annual 700-mile race for the Viceroy's Challenge Trophy, will start from Delhi in February.

The annual International good-will, air pageant at Montreal was held Aug. 19-20, with 50 airplanes from Roosevelt Field and vicinity flying en masse to participate. Unfavorable weather checked the ambitious program which had been arranged.



THE MONOPLANE JOSEPH LEBRIX

Fifty-six hours, 5,630 miles, and three Continents from New York, Paul Codos and Maurice Rossi landed their Bleriot monoplane at Rayak, Syria with a new world's straight-line flight record.

After many months of careful preparation, the final arrangements have been completed for the National Charity Air Pageant at Roosevelt Field, L. I., Oct. 7 and 8. Air races, aerial treasure hunt, aerobatics, military maneuvers, aerial bombardment, bomb dropping, Montreal contenders for the International Flying Trophy, motion picture stars, bands, entertainment, fashion show, and the National Championship Trophy with $10,000 in prizes for sportsmen pilots. Mrs. Franklin Delano Roosevelt is honorary chairman.

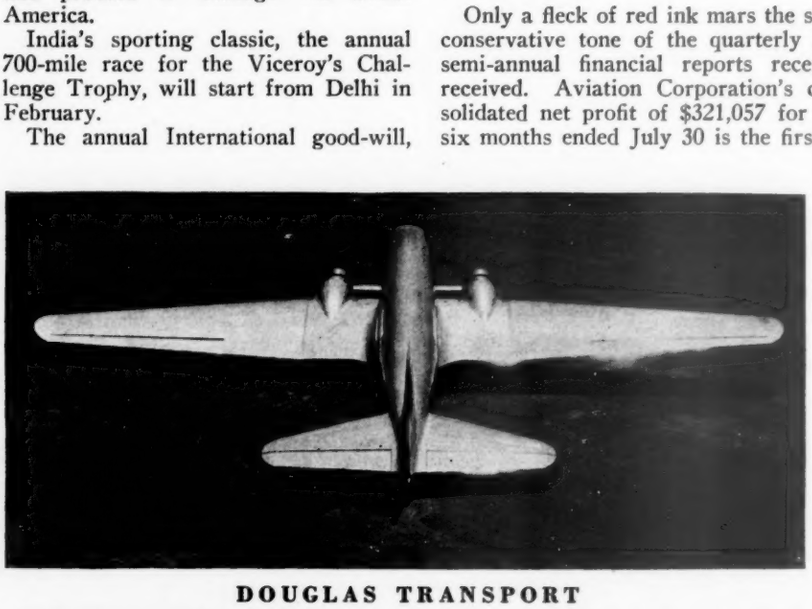
Corporations in the black

Only a fleck of red ink mars the solid conservative tone of the quarterly and semi-annual financial reports recently received. Aviation Corporation's consolidated net profit of $321,057 for the six months ended July 30 is the first in its history, March being the first month of profitable operation. During the corresponding period of 1932 the company lost $2,565,371. Current assets at the mid-year amounted to $11,154,945, of which $9,738,282 was in cash, government securities or the equivalent, and an additional $770,704 in general market securities. Current liabilities were $368,081, a ratio of about 30 to 1. The profit was about 12 cents on each of 2,762,000 shares of common stock outstanding.

The operations of Curtiss-Wright Corporation and its subsidiaries during the first half of the current year netted $428,073 after depreciation, taxes, interest and other charges, or 38 cents on each of 1,142,611 outstanding Class A shares, which earned only 3 cents each in the first half of 1932. Practically all profits resulted from second quarter operations, which earned $423,320 as compared with a net loss of $269,655 in the second quarter of last year. Wright Aeronautical Corporation, one of the company's principal subsidiaries, made a net profit of $430,481 after taxes and other charges in the first of the year, $325,097 of which was earned in the second quarter. Figures for the corresponding periods of 1932 were $366,590 and $31,866 respectively.

Largest per share earnings for the six months period were reported by United Aircraft and Transport Corporation, whose net income was $1,280,429 yielded about 50 cents on each of 2,086,671 shares of no par common stock outstanding after deduction had been made for preferred dividend requirements. Earnings in the first half of 1932 totaled $944,306. Profits from operations during the second quarter of this year reached $848,258, or 35 cents each on outstanding common shares, as compared with $502,861 in the same period last year.

To minority stockholders of its subsidiary, National Air Transport, United Aircraft has made an offer to acquire any or all of the outstanding shares for



DOUGLAS TRANSPORT

Performance specifications have been exceeded by the DC-1, transport, second commercial enterprise of the Douglas Company. Retractable landing gear, split trailing edge flaps, slotted ailerons and two small airfoils between the engine nacelles and fuselage are features. Two 700-hp. Wright Cyclones power this duralumin monocoque design which accommodates twelve or more passengers.

$20 a share. Only 8,000 shares of the 650,000 shares of N.A.T. stock have not yet been acquired by the United.

Depreciation charges ate up the $67,277 profit from the operations of North American Aviation and its wholly owned subsidiaries during the first half of 1933. Amounting to $214,928, they caused a net loss of $147,651 for the period. Inclusion of the company's equity in the net profit of a subsidiary not consolidated, but in which a majority stock interest is held, would reduce the loss to $104,756. These figures represent the results of the operations of North American Aviation as actually constituted during the six months just past. The company as it existed in the first half of 1931 lost $196,688.

More 1932 reports

The annual reports for 1932 which continue to come in are of another order. Curtiss-Wright Airports Corporation, subsidiary of Curtiss-Wright Corporation, lost $650,227 after charges of $110,900 for depreciation and amortization of leaseholds. However, 1931 losses, after deduction of $370,878 for similar charges, totaled $743,902.

National Parks Airways' 1932 net income of $33,101 compared with its 1931 earnings of $80,384.

Sales pick up

Many companies during the past month show an encouraging increase in airplane sales.

For transport work, the Army is now taking delivery of ten Bellanca Aircruisers, powered with geared "Hornet" 650 hp. engines.

The Stinson Aircraft Corporation reports shipment of $188,000 worth of single and tri-motored planes to buyers in this country and Central and South America in June, with orders amounting to $90,000 still on hand.

Waco deliveries continue upward. Among recent purchasers are Henry Dupont of Wilmington, Del., and Senor Francisco Mendez Concalves, director of civil aviation for the Argentine, both of whom took cabin planes.

F. A. Galligan, Fairchild West Coast factory representative, received shipment of a carload of 22's and 24's, recently, three of the airplanes being for immediate delivery.

Kinner Airplane and Motor Corporation reports shipment of a substantial order of engines to Mexico, and orders for engines and for the Kinner low-wing sportster have necessitated doubling the factory personnel. Consolidated Aircraft has delivered six Kinner-powered Fleets to the Mexican Government.

Aeronautics abroad

Italy has taken a highly original step by decreeing that commercial and public airplanes and engines after completion of a specified number of hours in the air shall be condemned. The decree states that an airplane of metal construction shall be condemned after 1,500 hours. The life of an engine is placed at 2,000 hours. [Many airlines in many countries have operated planes far beyond this period without the slightest deterioration.—Ed.] In exceptional cases an airplane or engine many continue in operation, providing they pass a rigid test, for an additional length of time equal to one-tenth of the allotted time.

The Government of Nicaragua is reported to have contracted with an Italian company—name yet unreleased—for air mail and passenger service throughout the republic. Approximately one million dollars will be spent in improving airports in Turkey during the coming year. The money will be raised by lottery by the Aviation League, which has been given the exclusive right to conduct lotteries in Turkey. Regular air service between Glasgow, Scotland and Belfast, Ireland, has been put in operation.

American pilots operating American-made planes opened a commercial airline between Shanghai and Canton, China, July 15. Eight passenger Junkers planes are being used on the newly established daily airline service between Durban and Johannesburg, South Africa. Daily air service was inaugurated between Berlin and Rome, with stops at Venice and Munich, during July. German civil aviation, under Air-Minister Herr Herman Göring, plans complete lighting of the airways and equipment of all planes with blind flying instruments.

Bigger zeppelin

Germany's newest and largest dirigible, the LZ-129, with a diameter 34 ft. more than that of the Graf Zeppelin and a length of 812 ft., will be ready for service next year. It will be the world's largest airship, with accommodations for 50 passengers, and a speed of 80 or 90 m.p.h. Though the motors have not yet been selected, it is certain they will be Diesels.

Before 40,000 persons at Soldiers' Field, Chicago, Lt. Comdr. T. G. W. Settle successfully took off on his proposed stratosphere flight, only to land again within a short time because of the gas escape valve's refusal to close after being opened. Descending in the night to land on nearby railroad tracks, Commander Settle was fortunate to find that only the gondola had been injured. He will try again upon conclusion of the international balloon race in which he is to be a contender.

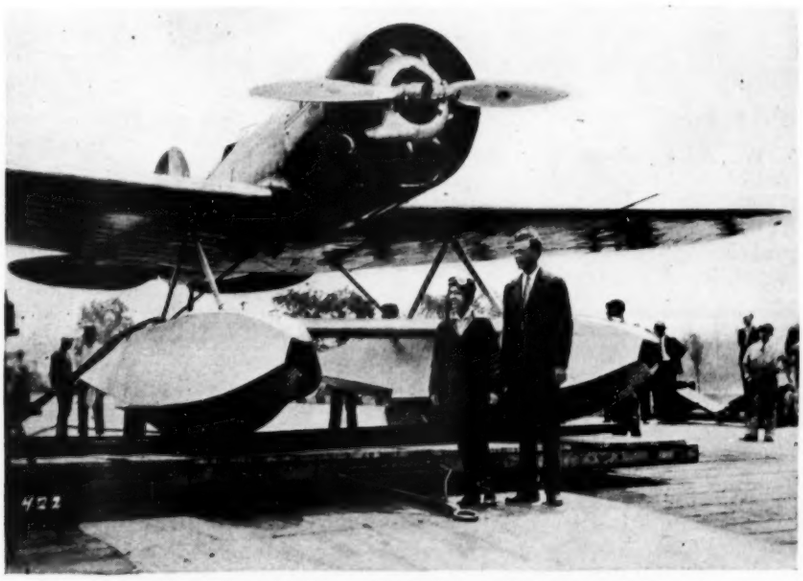
About the same time, Belgian physicist Cosyns' stratosphere balloon was severely damaged by an explosion.

Soaring

Sixty-two soaring planes participated in the fourteenth German soaring meet at the Wasserkuppe, Aug. 2-10. Of the 62, all except five had dihedral angles of 12 deg. or over. The American soaring meeting at Elmira, afflicted by persistent calms, ended without approaching last year's record. Longest flight, 18 miles, by A. F. Dupont.

"Fill her up?"

Now come aerial gas stations. Believing that private flying would in-



SURVEYOR-GENERAL LINDBERGH

Navigator Anne Morrow Lindbergh and Pilot Charles A. Lindbergh beneath their Lockheed seaplane just before their departure on a survey of a Northern air route to Europe.

crease considerably if plane owners could purchase gas and oil at minimum price, Capt. Al. Williams for the Gulf Oil Company has established the first such station on a field purchased by the company near Hicksville, L. I. Hangars are not part of the equipment—merely a gas station, a wind cone and a mowed field. The current price of fuel is displayed on a sign large enough to be read from 2,000 ft. altitude.

Airlines

Flying schedules have been speeded up by United between New York and Kansas City and points in Oklahoma and in Texas by better connections at Fort Worth and Dallas. American Airways, by lighting the New York-Buffalo route, is ready for day-and-night service between New York and Chicago. Celebrating its fifth anniversary, National Parks Airways extended its line by 210 miles from Butte to Billings, Mont.

Between Boston, Mass., and Bangor, Me., as a subsidiary of the Boston and Maine Railroad, a year-round air service was inaugurated Aug. 11. Amelia Earhart, with Paul Collins, former vice-president in charge of operations for the Ludington Lines, is in charge of the new service. Stinson tri-motors are used on a five-a-day schedule express to Portland, two going through to Bangor with intermediate stops. The schedule operated to make connections with Boston & Maine trains, has no mail contract. Another railroad entering into the aviation field is the New Haven, co-operating with the Island Airways Service. See page 292 for full account of this operation.

Effective Aug. 21, 1933, in California, a law requiring all intrastate aircraft operators to conform to the requirements laid down by the Department of Commerce for interstate transport operation.

Personnel

W. A. Patterson has been elected president of the operating companies of United Air Lines. New vice-presidents of United Air Lines are D. B. Colyer and Thorp Hiscock in the respective capacities of vice-president in charge of operations and director of radio and communications. Frank Caldwell will succeed Mr. Colyer as manager of Boeing operations.

Elected also was Carl L. Egtvedt to presidency and general manager of the Boeing Airplane Company, Seattle, Wash., Erik H. Nelson from sales manager to vice-president in charge of sales, and Gardner W. Carr to vice-president in charge of manufacturing.

Rear Admiral Richard E. Byrd, a member of the National Aeronautic Association since its organization, has been elected its vice-president. He succeeds Amelia Earhart, who resigned some time ago. Clifford W. Henderson has resigned as member of the Association Contest Committee and will be succeeded by Major R. Gilpin Ervin of the Shell Oil Company.

Dr. Jerome C. Hunsaker has accepted the appointment as head of the department of mechanical engineering of the Massachusetts Institute of Technology and resigned his position as vice-president of the Goodyear-Zeppelin Corporation.

ALAN WINSLOW, war ace, author, and air transport executive, age 37, died at Water Street Hospital, Ottawa, Canada, Aug. 15, as the result of an accident. Captain Winslow, a member of the 94th Aero Squadron, was the first American flier to bring down a German in the War.

For several years prior to his death he had been associated with the Foreign Department of Pan American Airways.

SIDE SLIPS

By Robert R. Osborn

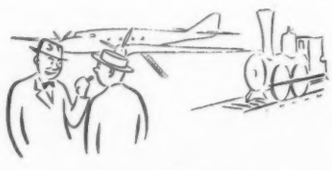
WE SEE by the papers that a new pickup device has been developed and demonstrated, by means of which an airplane in flight can pick up packages from the ground. According to reports a carton of eggs was picked up several times without breaking a single shell, to demonstrate the effectiveness of the machine. As the device apparently works entirely automatically and doesn't depend on the skill of the operator we are afraid that it isn't going to be very popular with future aerial expressmen. If they have the psychological outlook of their railroad predecessors they just won't be getting any fun out of life if

they can't damage at least a quarter of the contents of every package they handle.

Reading further, however, we find that packages are delivered back on the ground by dropping them into a chute of some sort. This may be the saving feature of the machine, for—think of the thrill the aerial expressman could get out of dropping your package into the next county and from about 5,000 ft.

Of course luck—well-managed luck, does play some small part in most successful ventures. In Wiley Post's amazing solo flight around the world he was very lucky to have a new propeller available when he needed one in Alaska. He was much luckier than a friend of ours who was flying in one of the OX-5 engine races which were so popular at the air races a few years ago. As is usual in the case of all racers he was still adding fairing to the fuselage as he taxied up to the starting line. As they warmed up the engine it was found that the propeller was pitched too high, so that the engine was not up to its normal ground r.p.m. A friend of his, who was watching the preparations, said, "I have just the prop you want. We have just ten minutes before the race starts. You start undoing those hub nuts and I'll run up and get it for you." By frantic and hectic work they managed to get the new propeller screwed down tight just as the starter was giving the flag to the first ship off. The mechanic pulled the propeller through, got the engine started and the pilot opened it up wide—and found it just an even hundred r.p.m. less than the first propeller! "Thanks, Pal, Thanks," said our friend as he opened the throttle and lumbered across the starting line.

The Intrepid Aviator has just returned from a visit to the Century of Progress exposition at Chicago. One of the large manufacturing companies has an old locomotive mounted alongside of their newest transport airplane, and, according to The Intrepid Aviator, several representatives of competing airplane



manufacturers are posted just outside of the exhibit to explain to visitors that the locomotive is the last year's model of the same ship and that the only difference between the two is that a retractable landing gear and a little fairing have been added.

TRANSPORT

Operations and Traffic Management

Personality for planes

TO THE rail traveling public many crack trains are referred to by name only. Thus, one does not take the 2 o'clock to Chicago, but rather boards the Century. By the same token there are the Wolverine, the Yankee Clipper, the Blue Comet, the Golden Gate Limited and dozens of others,—names to conjure with in current railroad history.

A similar idea was early adopted on European airlines and many tourists speak familiarly of the Silver Wing, the Rayon d'Or, or the Fleche d'Orient. Domestic lines have been slow to adopt the scheme but recently it has cropped up in several places. Notable examples: the Morning Metropolitan and the Morning Midwesterner of Pennsylvania Airlines, and the more recent Sky Chief of Transcontinental & Western Air. Perhaps many flights might profitably acquire a certain degree of personality by abandoning such prosaic designations as Trip 16 or Schedule No. 22.

An effective calling card

A CALLING CARD which has been designed to contain considerable airline information and still remain attractive in appearance is being used by traffic representatives of American Airways in the southern division. The card is folded so that the face is the conventional size; it contains the conventional information. The inside surfaces carry a number of the company's slogans, a statement about its equipment and an air transport map with American Airways routes shown in red. The rest of the map and most of the other lettering is in blue. This card serves as an interesting and novel souvenir of a traffic solicitation and is an effective medium for attracting attention.

Boosting the air mail

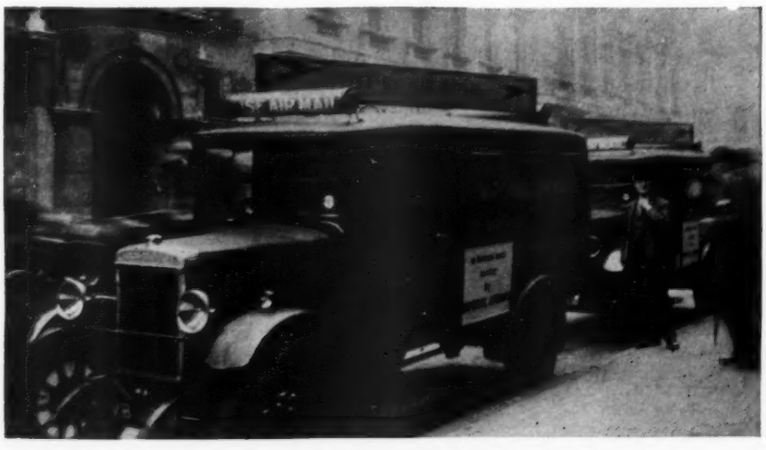
TO PROMOTE the use of air mail, especially to the Colonies, special stickers have been printed which are affixed to all books of stamps sold in post offices throughout Great Britain. The part of the sticker by which it is attached to the book carries the postal rate to India and to East and South Africa and urges the user to inquire at local post offices for posting schedules and for an air mail leaflet which is distributed free of charge. Two small stickers are attached which may be torn off and gummed to letters to go by air mail. These are about ¾ in. wide and 2 in. long, printed in white letters on a blue background with the legend "Bv Air Mail—Par Avion."

Perambulating publicity

THE attempt to invite airline patronage by means of gaudily painted passenger buses operating between downtown offices and airports is, fortunately, losing ground in this country. A certain amount of publicity of this type is perfectly legitimate but, since aviation has shed its side-show atmosphere, the circus-wagon type of bus should properly be replaced by more dignified designs. Trucks belonging to airlines used primarily for transport of baggage and express, fall in a slightly different category, however, and offer excellent means of keeping the services of a transport company in the public eye. The trucks used by Imperial Airways between Airways House in downtown London to Croydon, the terminal field, furnish excellent examples. Not only do the sides of the truck carry the company insignia and name, but vertical signs on the roof and reflecting transparencies fore and aft effectively urge the use of the air mail and the air passenger services.

Log book for passengers

SINCE we have an almost endless list of things for which log books must be kept—pilots, co-pilots, stewardesses, airplanes, engines, radios, storage batteries, spark plugs, etc., etc., ad infinitum—it may be not altogether unfitting and improper that the airline passenger be given an opportunity to keep his own log book. On a number of air lines passengers entering the ship are handed, among other things, small booklets bearing the title "Skylog." The covers and the front pages carry the insignia and certain publicity matter for the line over which the trip is to be made, together with the familiar admonitions to the customer as to proper airplane etiquette—why an airplane banks, why is a bump, and other such useful information. In the center of the booklet is found the log sheet proper, quickly detachable—complete with perforated edge and holes punched in the margin for subsequent binding. Appropriate blanks are laid out to be filled in with names of the pilot and co-pilot, time of arrivals and departures, miles flown, weather, and even the names of the fellow pasengers. The balance of the booklet is composed of paid advertising pages. The Skylog idea was evolved by one S. W. Hamilton, of Los Angeles, who owns the copyright. It is issued monthly.



Trucks awaiting their loads of mail, express and baggage in front of Airways House, Imperial's London office.

AIRCRAFT AT WORK

Call a (flying) cop!

IN many cities a radio call for police assistance brings the guardians of the law to the spot by land, sea and air. The New York Flying Police Force, organized some years ago under the Whalen régime, has had frequent occasion to prove its merit both in the rescue of many persons from harbor waters and in the pursuit and apprehension of criminals. Valuable work has also been performed in the study of street traffic. Points of undue congestion at certain hours of the day are readily located from the air and eliminated by the rerouting of surface vehicles.

An interesting example of police cooperation in the recovery of a stolen yacht took place recently. A 42-ft. cruiser belonging to Russell Garrett disappeared one night from the New Brunswick, N. J., Yacht Club. When inquiries failed to locate the missing boat, the owner chartered an airplane at Hadley Field and made a thorough search of the coastal waters of New Jersey, Staten Island, New York Harbor and Long Island. Within a short time the boat was located at anchor in Jamaica Bay. The searchers made a quick landing at Floyd Bennett Airport, headquarters of the New York Flying Police, and presently took off in company with one of the police amphibians. In a matter of minutes, the police ship landed alongside the cruiser and the astonished yacht robbers were in custody almost before they were aware of what was happening.

Extensive tests have recently been undertaken by officials in the Philadelphia district to determine the effectiveness of the autogiro for police work. Radio equipped giros were used to trace an automobile cross-country (presumably containing fleeing criminals) and a very striking demonstration of the probable outcome of such a chase was staged on Pitcairn Field at Willow Grove. The automobile with its steering gear locked was made to operate in a wide circle in the middle of the field. Overhead from an autogiro piloted by J. Paul Lukens, Police Chief Theodore Hallowell opened fire with a sub-caliber machine gun. At the first burst the body of the car was riddled and with the second fusillade, the vital parts of the motor were reached, and the car was stopped in flames.

Dawn to dusk

SOME 1,300 miles traveled, with stops to visit dealers in seven states and in Canada, was the record lately hung up by Jerry Hadley, assistant general manager of the Auburn Automobile Company, and W. A. Mara, vice president of the Stinson Aircraft Corporation, on sales tour. Their Stinson Model R monoplane cleared Detroit at crack of dawn and a quarter of eight found them over the Chicago airport. Their business completed, they turned the nose of their ship southeast, landing at Indianapolis and at Louisville at 9:56 and at 11:19 respectively. Stops were made at Cincinnati and at Columbus and the ship was down at the airport at Pittsburgh at 3:50 p.m. Five fifty-eight found them at Buffalo from which point the course was laid straight across the Province of Ontario to Detroit, reached at 8:25 p.m. The plane made an average speed of 105 miles an hour for fourteen hours and 48 minutes including all stops.

By pre-arrangement the dealers came to the airports where Mr. Hadley discussed with them plans for a selling campaign. To make the same trip by train would have required three nights and three days and would have cost $84.43 per passenger. The total cost by plane including gasoline and oil, depreciation, insurance, storage and maintenance, came to just $39 per passenger, showing a net saving of two days and three nights and $45.43 on each.

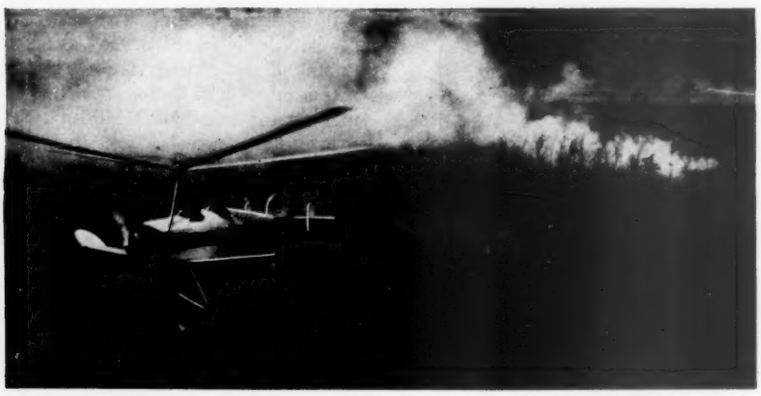
Antidote for hungry locusts

AN annual bill of over $25,000,000 for damages to crops and vegetation by locusts has furnished incentive for British and African authorities to co-operate in studying ways and means for exterminating the pests. Ground methods of control having failed, the fight is now being carried into the insect's natural element, the air. Experts at the War Office Chemical Department on Salisbury Plain are studying methods for exterminating locust swarms on the wing. Methods are being developed whereby airplanes can attack the locusts and destroy them by releasing clouds of chemicals in their path.

An interesting feature of this research was the importation from Nairobi, Africa, to London of several crates of insects for study in the laboratories. Since speed was essential to preserve the lives of the specimens, Imperial Airways handled the shipment, making delivery in seven days. Although there was a certain mortality en route, there were sufficient live locusts delivered for test purposes. Wind tunnels were used for some of the experiments to determine the toxic effect of various gases and chemicals upon the insect in flight.

Autogiro fire patrol

DURING the past year the State of New Jersey, under the supervision of Colonel Leonidas Coil, State Fire Warden, has been conducting extensive tests to determine the value of the autogiro as a means of controlling destructive brush and forest fires. It has been found that the giro is particularly adaptable to this type of service on account of its ability to hover over small areas at low altitudes to permit a leisurely and detailed examination of conditions below. It is also possible to make landings in small clearings or other restricted areas to contact fire-fighting crews on the ground. The effectiveness of the giro patrol has been tremendously increased by the installation of two-way radio communication. With such equipment it is possible for a warden or other executive to direct the activities of scattered fire-fighting crews over a large territory.



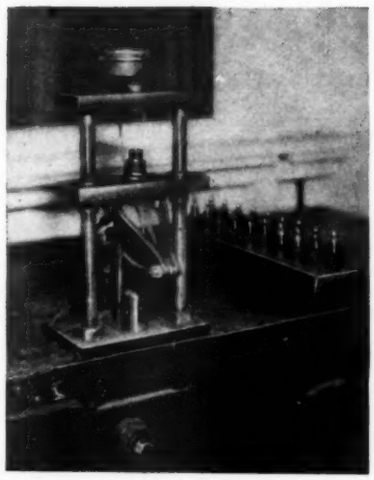
Pitcairn autogiro on patrol over a New Jersey forest fire.

SERVICING SHORT CUTS

P.A.A. spark plug tester

IN DISCUSSING the maintenance of airplanes and engines at Pan American Airways Brownsville base ("Thunder Bird's Nest," AVIATION, February, 1933) mention was made of a testing device which permitted rapid checking of spark plugs after overhaul. This device which was developed at Brownsville has proven so successful that it has been adopted at Miami and other P.A.A. bases where spark plugs are removed from engines. Instead of the usual procedure of screwing plugs one by one into a test chamber, turning on high pressure air, then passing high tension current through them, the job is done at one operation. The plug to be tested is dropped head down into a socket in a sliding crosshead. Depressing a foot treadle automatically performs the following operations in order: (1) pushes the firing end of the plug upward into an air-tight pressure chamber (the pressure from the toggle action being sufficient to make an air-tight seal between the plug and the rim of the chamber); (2) after the chamber is sealed, admits air under 100 lb. per sq.in. pressure, and (3) after the air pressure has reached its maximum value in the chamber, applies high tension current to the terminals. A glass top in the pressure chamber permits the action of the plug to be observed by the operator. A small gage, also readily visible to the operator, indicates the actual chamber pressure at each shot. Removing the foot from the treadle withdraws the plug and resets the apparatus for the next test.

With this device plugs may be tested very rapidly, as it is not necessary to take the time to screw each tightly into the compression chamber. All the necessary operations are accomplished with the simple motion of the foot treadle and the operator's hands are left free to insert and remove the plugs.

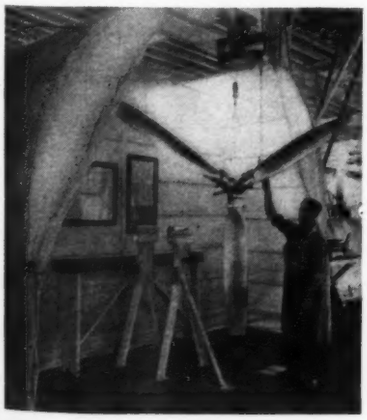


Spark plug tester.

Propeller balancing stand

OF INTEREST among equipment used at the Navy's aircraft and engine overhaul base at Pensacola, Fla., is a propeller balancing stand and its auxiliary equipment. As with many stands of this type, it straddles a pit in the shop floor. To prevent damage to the accurately ground and hardened knife edges, two soft brass notched bars are arranged to receive the propeller mandrel. These members are supported on the pistons of small air cylinders (one on each side) which are controlled by means of a single three-way valve. After the propeller is placed on the receiving arms, support can be transferred to the balance ways by slowly releasing air from the cylinders. In this way the knife edges are protected against damage from accidental dropping of the propeller while it is being placed in the stand.

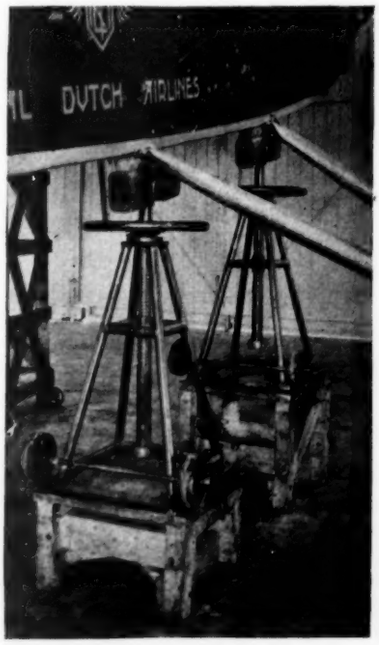
Since it was impractical to mount the balancing stand in a small enclosed room (as is common practice in many airline maintenance shops) the balancing stand at Pensacola has been surrounded by a light pipe frame covered with cloth to form a sort of booth. A small workbench has been built inside the enclosure, and propeller charts and other necessary data are framed and hung on the rear wall of the booth for ready reference. Propellers are handled to and from the balancing stand by means of a light I-beam jib crane pivoted to one of the shop pillars. The crane is swung, and the trolley is traversed by hand, but the lift is operated by compressed air. With this device any propeller can be handled by one man.



The Navy's propeller balancing equipment at the Pensacola Air Station. (U. S. Navy Photo)

K.L.M. wheel inspection

FROM time to time we have illustrated in these columns a variety of jacks and other lifting devices used in the shops of American air lines for the maintenance and servicing of wheels and brakes. Through the courtesy of Dr. A. Plesman, Managing Director of the Royal Dutch Airlines, whose ships ply weekly the 8,000-mile route from Amsterdam to the tip of the Malay Peninsula, we are able to show how the same job is done in one of the outstanding European shops. Four jacks with welded steel tube frames are used to raise the three engined Fokkers, one jack under each of the undercarriage attachment fittings on the lower longerons. The jacks are of simple construction, each consisting of a stout square-threaded screw held in vertical guides and operated by a nut in the center of a hand wheel of large diameter, An interesting feature is the attachment of a cross axle and pair of small cast iron wheels to facilitate moving the equipment about the shop.



Portable lifting jacks used in the Amsterdam shops of K.L.M. for wheel and brake servicing.

THE BUYERS' LOG BOOK

AVIATION'S *Card Index of New Equipment*

This department is equipped to help readers locate manufacturers of any parts, accessories or materials.

MATERIALS — **Abrasives, sandpaper**

Produced by a number of manufacturers of abrasives for distribution through retail and supply channels.

AN electrostatic method of depositing abrasive particles on glued paper or cloth backings is now being used by leading sandpaper makers. Improved uniformity of coating increases sanding and grinding efficiencies 30 to 40 per cent. Available in all popular abrasives including garnet, aluminum oxide, silicon carbide. Backings and forms made up to users requirements.

AVIATION, *September, 1933*

SHOP EQUIPMENT — **Overhead trolley systems**

Bull Dog Electric Products Company,
Detroit, Mich.

TROL-E-DUCT is a mobile trolley system to convey electric current to portable electric tools such as drills, screw drivers, buffs, lights, etc. Consists of standardized sections of steel duct enclosing insulated busbars to distribute current. Made in three sizes for light, medium and heavy duty. Eliminates danger and confusion of multiple extension cords in shop or hangar.

AVIATION, *September, 1933*

PARTS — **Bearings, ball**

The Norma-Hoffman Bearings Corporation,
Stamford, Conn.

TO satisfy a demand for extremely small ball bearings of the precision type the N-463 ($\frac{1}{8}$-in. bore, $\frac{3}{8}$-in. OD.), and the 4666 ($\frac{3}{16}$-in. bore $\frac{1}{2}$-in. OD.) models have been added to the standard line. They are equipped with twelve and seventeen balls respectively ($\frac{1}{16}$-in. diam.). Useful for both rotating and oscillating loads in precision instruments, scales, relays, etc.

AVIATION, *September, 1933*

SHOP EQUIPMENT — **Regulator, welding**

The Alexander Milburn Company,
1416-1428 West Baltimore Street, Baltimore, Md.

MICROMETER adjustment of welding gas pressures is the function of a new regulating valve. The usual main regulator key has a smaller, independently operated fine adjustment key recessed into it. A range of 0-5 lb. is covered by the fine adjustment beyond the setting given by the main key. Older model regulators may be changed over to new style by substitution of standard parts.

AVIATION, *September, 1933*

RADIO — **Headset, receiving**

Western Electric Company,
New York, N. Y.

MIDGET receivers with flexible rubber earpieces are now available for use with aircraft radio receivers. No headband is required, as the receiving units are supported by the convolutions of the external ear. Five sizes are available from which any normal ear may be fitted without the necessity of making plaster casts. Weight complete with cord, 3 oz. (Std. headset, 14 oz.)

AVIATION, *September, 1933*

SHOP EQUIPMENT — **Paint spray gun**

The DeVilbiss Company,
Toledo, Ohio

THE new MB type spray gun incorporates a number of improvements over older models. The air passages have been redesigned to give improved atomization, smoother covering and reduced wastage. Spray needle valve now operated by air position under trigger control, making trigger action light to operator's touch, reducing hand fatigue, etc. Can be applied to any spray system.

AVIATION, *September, 1933*

SHOP EQUIPMENT — **Goggles, welder's**

The Linde Air Products Company,
30 East 42nd Street, New York, N. Y.

OXWELD No. 15 goggle, with new Type AA lens offered for improved protection and comfort to operator. Canvas bakelite frames, non-inflammable, with insulated bows. Lenses flat ground and polished in light, medium and dark green shades, conform to all safety code requirements. 50 cm. diam. gives wide angle vision. Special frame adjustment permits quick change of lenses.

AVIATION, *September, 1933*

MATERIALS — **Inconel**

The International Nickle Company, Inc.,
67 Wall Street, New York, N. Y.

INCONEL, a new nickle alloy, is being tested on a number of planes for exhaust stacks and collector rings. Composition: nickle, 80 per cent; chromium, 14 per cent; iron, 6 per cent. It is not subject to carbon embrittlement and therefore annealing after welding is not necessary. Since carbon absorption is nil, a reducing flame is recommended for welding.

AVIATION, *September, 1933*